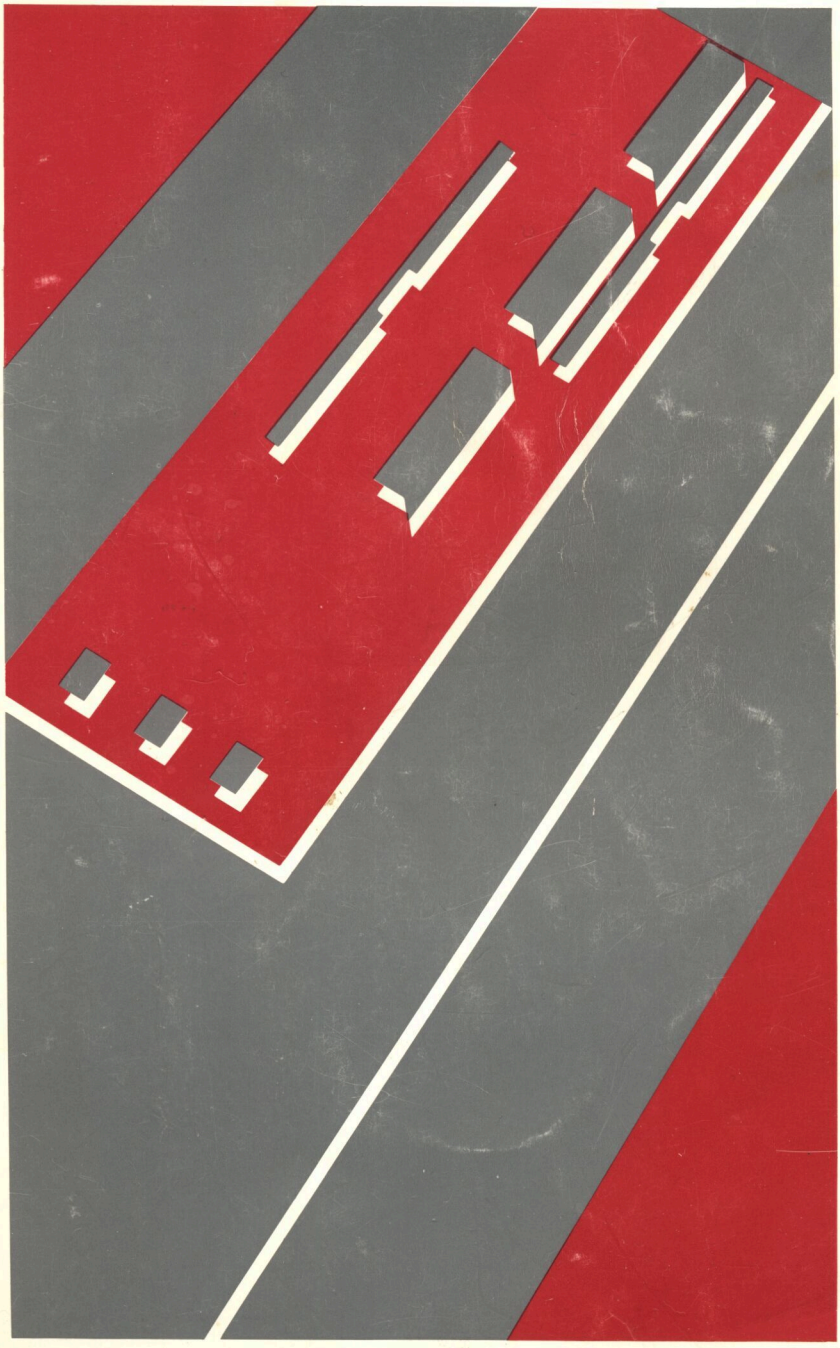
CITIZEN

USER'S MANUAL

120D+



DOT MATRIX PRINTER

CITIZEN

120D +

USER'S MANUAL

Trademark Acknowledgement

Citizen 120D + : Citizen Watch Co. Ltd., Japan
Amstrad: Amstrad CPC
Apple, Apple II, Applesoft BASIC: Apple Computer Inc.
Atari, Atari BASIC: Atari, Inc., a Warner Communications Company
Commodore, Commodore BASIC: Commodore Business Machines, Inc.
CP/M: Digital Research
Diablo: Xerox Corporation
Epson LX, Epson FX: Epson America Inc.
IBM Personal Computer, IBM PC, IBM Graphics Printer: International Business Machines Corp.
Kaypro: Kaypro Computer Corporation
Microsoft BASIC: Microsoft Corporation
Sanyo: Sanyo Corporation
Spinwriter: NEC Information Systems, Inc.
TRS-80, TRS-80 Model III, TRS-80 Basic: Radio Shack, Tandy Corp.
WordStar: MicroPro International Corporation

INTRODUCTION

Your new Citizen 120D+ printer represents the state of the art in dot matrix printers, with all the features of a printer that would cost much more. It is designed to work with almost all of today's microcomputers in a wide variety of applications, using either commercial software or your own programs.

The Citizen 120D+ is capable of all the printing functions you would expect of a top-quality dot matrix printer, as well as some additional features you may not expect:

- Expanded, compressed, emphasised, and doublestrike print, italics, superscripts, and subscripts
- Correspondence standard, near letter quality print, dual pitch, high speed mode and reverse white-on-black print
- Built-in international characters for 11 countries as well as line and block graphics and accented characters
- Dot-addressable graphics in six densities
- Two self-tests: a comprehensive printer self-test that prints all of the 120D+'s standard characters as well as line and block graphics and accented characters, and a maintenance self-test that identifies the version of the control program, the dipswitch configuration and character generators and performs a printing alignment test
- A hex dump feature that is a powerful program debugging feature, printed in a format that is unprecedented in the printer marketplace. It not only prints the hexadecimal value of every code it receives, but also prints all the corresponding characters *and* the control code abbreviations. (Most printers either print only the hex codes or just the corresponding characters and not the control codes.)
- And at 120 characters per second and 144 characters per second in high speed elite mode, the Citizen 120D+ will make short work of your printing needs!

If versatility and ease-of-use is "the name of the game", the Citizen 120D+ is a step ahead of its time! Check these additional design features:

- Your Citizen 120D+ printer is designed to be like two printers in one. It can act just like an Epson FX or Epson LX printer, or, with the flip of a switch, it can act just like an IBM Graphics Printer. And the Epson FX/ LX configuration has two different combinations of printer functions!
- The standard tractor-feed mechanism can be installed and removed in seconds. In fact, you'll see that the entire printer can be easily assembled in just a few minutes.
- The standard parallel (and optional serial) interface is cartridge-removable. Slip one interface cartridge out and insert another — it's really that simple!
- The 120D+'s internal switches are conveniently located on the interface cartridge. This means no more searching inside the printer or completely removing the cover to access the internal switches. You can quickly make adjustments to the switches that control many of the 120D+'s functions. (In addition, many of the switch functions can be controlled by software commands.)

ABOUT THIS MANUAL

This *120D+ User's Manual* is a complete, concise manual that is well illustrated and highly informative, yet plainly written. The manual is written not just for the computer expert who wants to know about hex codes and bit maps, but also for the non-programmer who simply wants professional printing results. With this manual, learning to use your 120D+ printer will be a fast, easy and pleasant experience.

Before you unpack your printer (no matter which type of user you are), you should begin by reading Chapter 1. It tells you how to unpack and set up your printer.

When you have the 120D+ set up and connected to your computer, read Chapters 2 and 3. Chapter 2 covers the basics of dot matrix printing and how the 120D+ interacts with your computer and your software. Chapter 3 provides information about using BASIC and advice on how to program the printer when using certain computers.

Chapter 4 gets you started printing. In fact, if you plan to use your printer only with commercial software and are not interested in programming, you can skip the next six chapters and just read Appendix A about maintenance. (We told you it was fast and easy!)

If you plan to do your own programming or design custom graphics, Chapters 3 through 9 and the appendices are for you. These chapters contain explanations of all the features. Example programs, written in Microsoft BASIC, will show you how to send the commands to the 120D+ printer. If your computer does not use Microsoft BASIC, you can modify the programs for your computer as discussed in Chapter 3.

If you plan to write your own programs, you'll find the example programs handy as subroutines. If you don't know BASIC, you can still use all of the 120D+'s features. Just copy the codes in the example programs. (So that your sample programs come out the same, this manual assumes that you have configured your 120D+ as an Epson FX/LX printer; see Appendix D for Epson configuration options.)

The appendices provide handy reference guides to maintenance, the 120D+'s codes, internal switch settings and specifications. Appendix A is about maintenance and should be read by everyone. It tells you how to take care of your 120D+ printer so that it maintains its high quality of printing.

Congratulations on your wise investment and enjoy your new Citizen 120D+ printer!

TABLE OF CONTENTS

CHAPTER 4

CHAPTER 5

TABLE OF CONTENTS

TABLE OF CONTENTS

CHAPTER 1
SET UP

This chapter will help to set up your new Citizen 120D+ printer. You'll see how to pick a suitable location for your printer and unpack its components. You'll also learn how to install the ribbon, load paper and connect the printer to your computer.

PRINTER LOCATION

Before you set up your printer, you should think about the best location for it. Near your computer, obviously. But here are a few other considerations:

- Choose a flat, sturdy surface with enough room for the paper to flow freely into and out of the printer. If you use continuous fan-fold paper, you'll need space behind the printer (or underneath with bottom-feeding) for a stack of paper.
- Position the printer so that connecting its power cord and computer cable will not interfere with the paper flow.
- Place a protective mat between printer and wood surface to avoid possible damage to surface.
- Avoid areas subject to excessive heat (direct sunlight, for example), humidity, dust or grease.
- Provide a steady source of 220/240-volt electricity. Motors, and many appliances (copiers, heaters, refrigerators, air conditioners, for example) cause fluctuations in the power line. You may want to use a surge protector which guards against power fluctuations. There are many good ones available.

UNPACKING AND ASSEMBLY

As you unpack your 120D+ printer, set aside and save the packing materials. They are specially designed to protect the printer and will come in handy in case you ever need to ship it.

You should find 5 items in the box as shown in Figure 1-1. Check to make sure each item is there. If anything appears damaged, contact your dealer immediately.

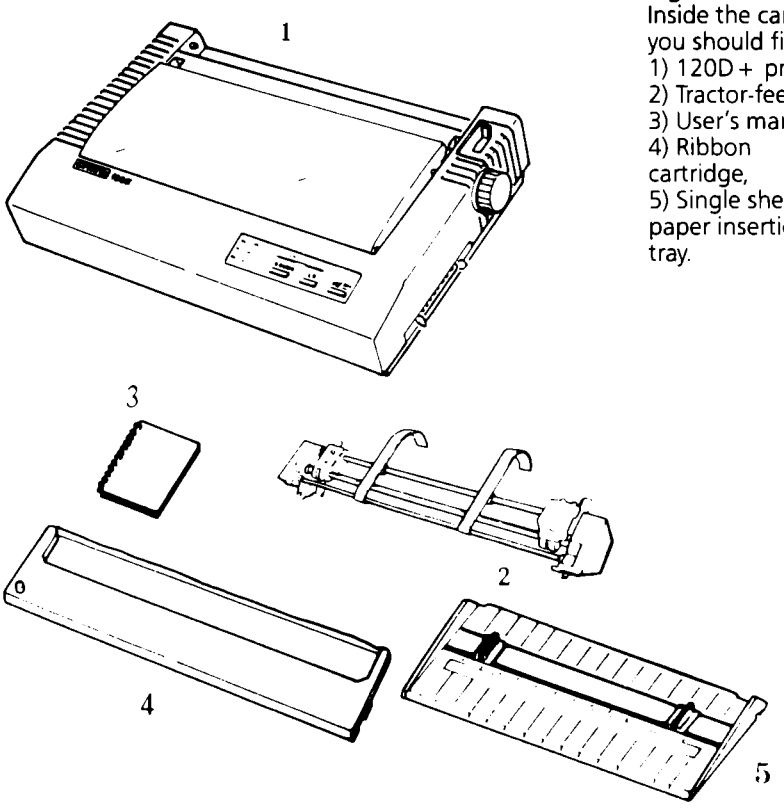


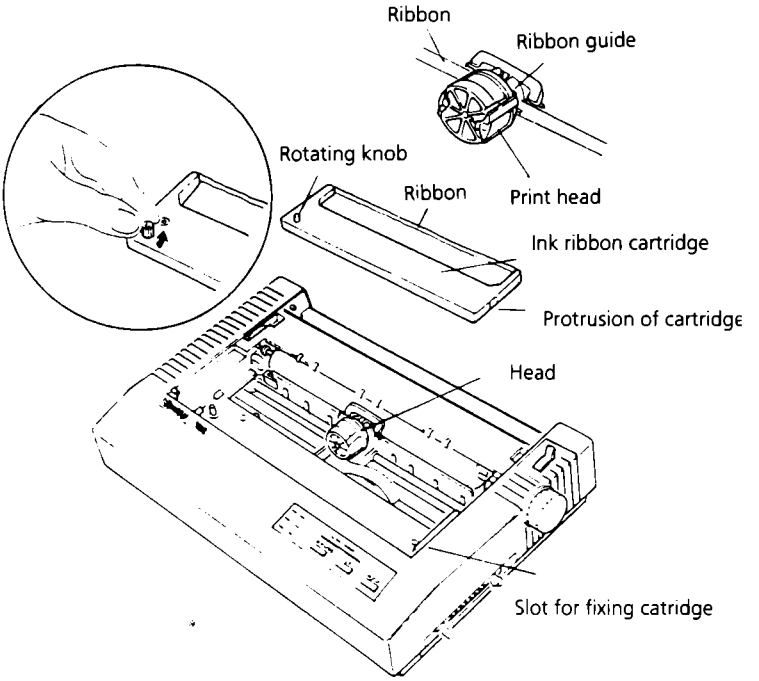
Figure 1-1. Inside the carton you should find:
1) 120D+ printer,
2) Tractor-feed unit,
3) User's manual,
4) Ribbon cartridge,
5) Single sheet paper insertion tray.

Installing the ribbon

The printer ribbon is enclosed in a cartridge and is very easy to install. Remove the *ribbon cartridge* from its packing materials and open the printer cover. Holding the cartridge with the round knob facing up and the ribbon facing the back of the printer, place the cartridge in position behind the print head as shown in Figure 1-2. Then gently push the cartridge down until it snaps into place.

Slide the ribbon into place between the print head and the metal ribbon guide. (The print head should be near the middle of the printer to make this easier.) Remove any slack in the ribbon by turning the round knob on the cartridge clockwise and close the printer cover.

Figure 1-2.
Installing the ribbon cartridge.



CAUTION: If you are replacing a ribbon cartridge, turn the printer power off and slide the print head to the right before removing the old ribbon, to avoid damaging the print head cable.

Installing the printer cover

With the ribbon installed, you can replace the printer cover on top of the printer. Holding the cover at about a 45 degree angle (see Figure 1-3), insert the two slots on the cover into the tabs on the printer case and press down on the rear edge of the cover until it snaps in place. Then lower the cover on to the printer.

The printer cover has three basic positions: all the way closed during printer operation, all the way open (towards the front of the printer) when you need to access the inside of the printer, and open about half way to remove the cover from the printer.

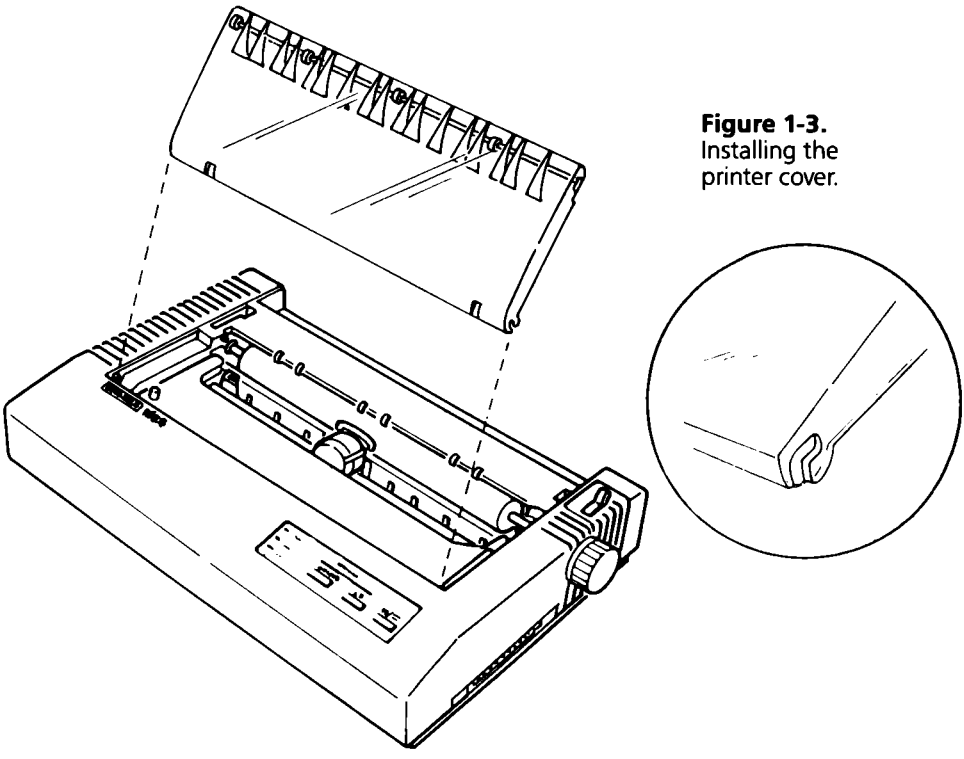


Figure 1-3. Installing the printer cover.

GETTING ACQUAINTED

With the preliminaries out of the way, let's take a closer look at the 120D+ printer's components and controls to see what they do. Each item is shown in Figure 1-4.

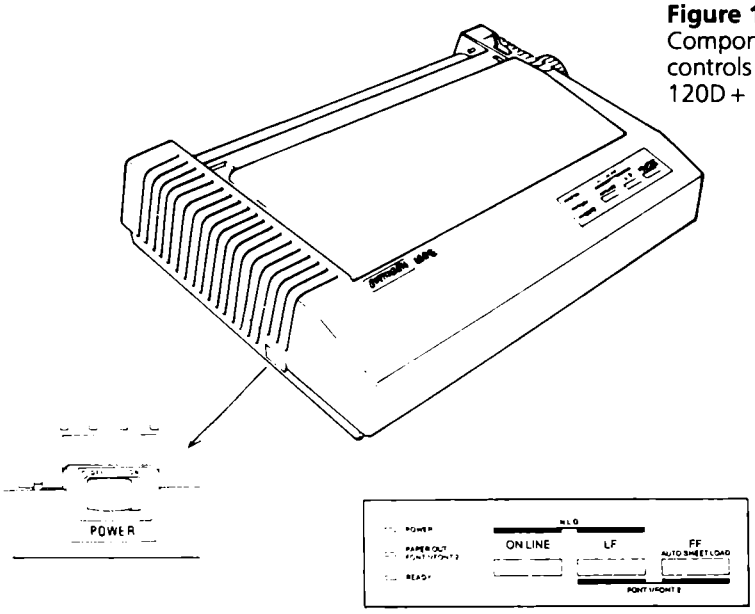


Figure 1-4. Components and controls of the 120D+ printer.

Printer components

Power switch.
The power switch is used to turn power to the printer on and off. It is on the left side near the front.

Platen
The platen is the hard rubber cylinder that carries the paper to the print head.

Paper feed knob.
The paper feed knob, located on the right side of the printer, turns the platen. By turning this knob, you can manually advance the paper.

Paper select lever.
The paper select lever adjusts the pressure on the platen according to the type of paper being used. This lever is on the top right of the printer, near the back.

The paper select lever has two positions: front and back. The front position is used with single sheets or with continuous paper without the tractor-feed mechanism. The back position is used with continuous paper when you have installed the tractor-feed.

Paper thickness lever.
The paper thickness lever adjusts the distance between the platen and the print head to accommodate forms with up to 3 carbonless copies. The paper thickness lever is located just in front of the platen, on the right.

Printer cover.
The printer cover is actually a dust cover, noise buffer, paper bail, and paper cutter — all in one! This cover protects the 120D+ printer from dirt and dust as well as reduce the sound level while printing. The cover has a bar with three rollers on the inside which secure the paper against the platen, and a special beveled edge acts as a paper cutter for tearing off the paper.

The control panel

The *control panel* (Figure 1-5) is located on the right front of the 120D+ printer. It consists of three soft-touch switches and a panel with three status lights.

Power light.
The power light glows green when power to the printer is on.

Paper out, Font 1/Font 2 light
The paper out light flashes red when the printer is out of paper, and when home position error occurs (the carriage return does not move normally). This light is also used to indicate the printer has accepted a Font change command as described in the next section.

Ready light.
The ready light glows green when the printer is ready to accept data from the computer. During normal printing it will flicker as the printer tells the computer to stop and start sending data. This flicker is normal.

On-line switch.
The on-line switch determines whether the printer is controlled by the computer and is able to receive data, or is controlled by the other control panel switches. When "on-line" (indicated by the green ready light), the printer is controlled by the computer and the other control panel switches are inoperable. When "off-line" (the green light is not on), information from the computer is suspended and the other control panel switches can be used.

LF (Line Feed) switch.
When the printer is off-line, the line feed switch advances the paper one line each time it is pressed. You can advance the paper as far as you like by holding down the switch.

FF (Form Feed) and Auto Sheet load switch
When the printer is off-line, pressing the form feed switch advances the paper to the top of the next page or can advance a new sheet automatically for you.

The control panel switches also play a part in turning on three of the 120D+'s very special features: the printer self-test, the maintenance self-test, and the hex dump feature.

The two self-tests are covered later in this chapter; the hex dump feature is described in Chapter 9.

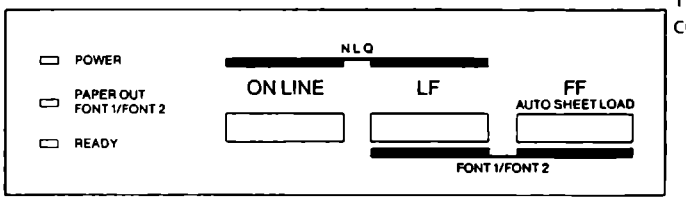


Figure 1-5.
The 120D+ printer control panel.

CONTROL PANEL PROCEDURE

The control panel will allow the operator to access seven different print styles, two character font styles and ASF/forms length selection.

To enter the print style select mode with the printer ON LINE, the operator will depress the FF button (hold it down) and then depress the ON LINE button.

When the operator enters the print style mode the printer will clear itself to the standard mode and the ready light will start flashing.

To access each of the print styles shown as below, the operator will depress the ON LINE button. For example, the operator will depress the ON LINE button twice (2) to access the ITALIC mode.

Each time the operator depresses the ON LINE button, the "PAPER OUT" light will flash.

After accessing the desired font mode, the operator will then depress the FF button and release it.

The operator will then depress the LF button, which will take the 120D+ out of the print style select mode.

Print style	Select
Draft (Power on default)	0
Near Letter Quality (NLQ)	1
Italic	2
Emphasised	3
Reduced	4
Double height/width	5
Quadruple height/width	6

Only one (1) style will be accessable in another manner than that stated above. This is the NLQ font. To access the NLQ style without entering the print style select mode, the operator will depress the LF button and hold it in. They will then depress the ON LINE button and hold it in. Both buttons may then be released. Upon their release the 120D+ will enter the NLQ mode. To exit this mode, the operator need only repeat the above procedure.

The two resident internal character font styles can also be accessed from the front panel by using a combination of the LF and FF buttons. The use of these buttons is underlined Font 1/Font 2 to help your remember for future use.

With the printer ON LINE hold down the FF button and press the LF button once. The print style from your printer will now have changed. Repeating this operation will return your printer to the character font style as configured by the dipswitches. So that you can be sure that your command has been noted by the 120D+, the paper out light will light once on Font 1 selection and twice on Font 2 selection. Try it out its easy!

It is also possible to use the front panel to vary the length of paper that the 120D+ will feed for you. This feature is selected by: With the printer ON LINE hold down the LF (line feed) button and then press the FF (form feed button). The 'ready' light will now flash. Now press the ON LINE button for the required selection from the following table:

---

0 = Standard Default
1 = ASF (Sheet feeder option mode)
2 = 6'' forms length
3 = 11⅔'' forms length

With the required selection made, press and release the FF button followed by the LF button and the printer is now set.

SELECTING AND LOADING PAPER

The 120D+ printer can be used with single sheets or continuous fan-fold paper. Fan-fold paper, also called pin-feed or continuous paper, is what you probably think as computer paper. It consists of continuous perforated sheets with punched holes along the sides. It is available plain, or with coloured stripes.

Continuous letterheads, pre-printed forms, labels and envelopes can also be used with the 120D+ printer. The 120D+ can handle any of these up to ten inches wide.

The paper select lever

The *paper select lever* (shown in Figure 1-6) sets the type of paper feed the 120D+ uses. It has two positions: front and back. The front position is used with single sheet paper. In this position, the pressure on the platen is increased so that the paper is fed by friction.

The back position (towards the rear of the printer) is used with continuous paper when the tractor-feed mechanism is installed. In this position, the platen pressure is released so that the paper is fed by the movement of the tractor's sprocket pins on each side of the paper.

The back position can also be used to adjust the alignment of any type of paper because it releases the pressure on the platen.

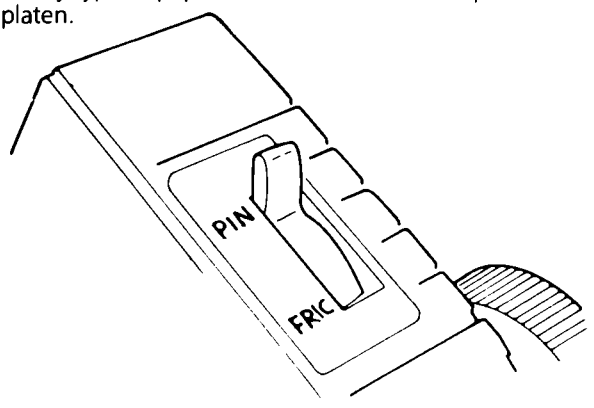


Figure 1-6. The paper select lever has two positions for loading different types of paper.

Loading single sheets

Loading single sheet paper into the 120D+ printer is very much like putting paper in a typewriter. Here's how to load single sheets:

1. Move the paper select lever forward.
2. Insert a sheet of paper into the paper slot behind the platen. The paper should slide in about one inch.
3. Advance the paper (around the platen) to the desired position by manually turning the paper feed knob.
4. If necessary, make any adjustments to the paper with the paper select lever back and then return the paper select lever to the forward position.

Now you are ready to print. You can also load paper using the LF (line feed) switch:

1. If you haven't already done so, plug in the power cord.
2. Turn the power switch on. You should see the Power light come on and the paper-out (Fault) light flash. The Ready light will be out at this point which means the printer is off-line.
3. Move the paper select lever forward and insert a sheet of paper into the paper slot.
4. Press and hold the LF switch until the paper advances to the desired position, or press and hold the FF/AUTO SHEET LOAD switch once. The paper advances automatically to the position which is about one inch exceeding from the first printing line. It is called AUTO SHEET LOAD.
5. If necessary, make any adjustments to the paper with the paper select lever back, then return it to the forward position.
6. Press the ON LINE switch; the paper-out light will go out and the Ready light will come on which means the printer is on-line.

You are ready to start printing.

Installing the tractor-feed mechanism

The tractor-feed mechanism is used with continuous paper, labels or forms. It uses two sprockets, or *tractors,* which can slide back and forth to adjust to the paper width. The tractors are held in the desired position with locking levers (see Figure 1-7).

The pins on the tractors fit into the holes along the edges of the paper. The flip-up covers on the tractors clamp the paper in place on the pins. With each new line, the tractor pins move and pull the paper around the platen and through the printer. *Paper supports,* which can be adjusted left or right, guide the paper out of the printer.

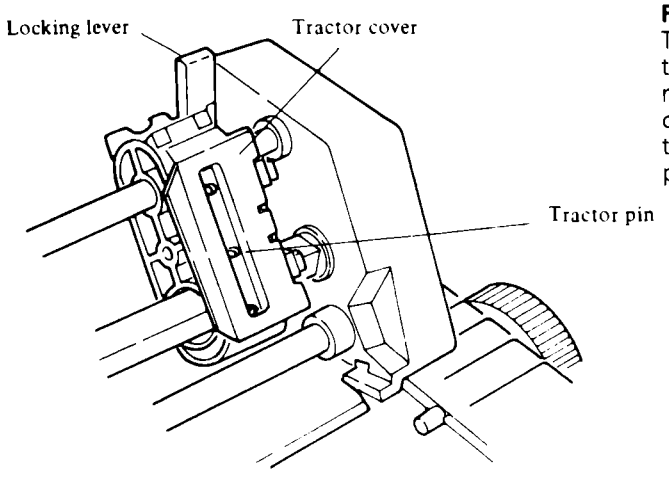


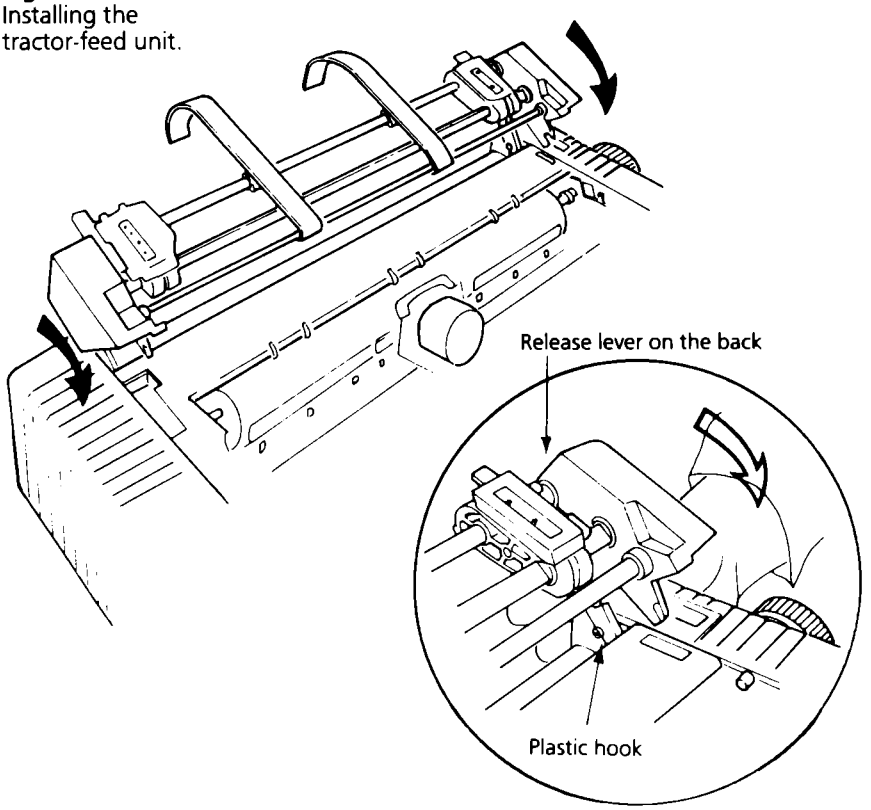
Figure 1-7. Tractors on the tractor-feed mechanism feed continuous paper through the printer.

Here's how to install the tractor-feed mechanism:

1. Remove the printer cover.
2. Push in the two release levers on the back of each end and place the plastic hooks on the bottom of the tractor into the tabs on the printer (see Figure 1-8).
3. Set the tractor unit on top of the printer as shown in the illustration. When you let go of the release levers, the tractor locks into place.
4. Install the paper supports and space them evenly on the tractor unit.

You can leave the printer cover off for now to load the continuous paper described in the next section.

Figure 1-8.
Installing the tractor-feed unit.



Loading continuous paper

Continuous paper can be loaded through the rear of the printer, just behind the platen (explained below), or through the bottom of the printer (see the next section on bottom-feeding the printer).

Let's first load continuous paper from the rear of the printer. Here's how:

1. Remove the printer cover (if installed).
2. Turn power switch off and slide the print head to the centre position.
3. Move the paper select lever forward and open the tractor covers.
4. Flip the locking levers forward and adjust the tractors to the approximate paper width. Adjust the paper supports so that they are evenly spaced.

5. Place a stack of paper on a level surface behind the printer. As shown in Figure 1-9, bring the top sheet of paper forward and insert it into the slot just behind the platen (the same place you feed single sheets).

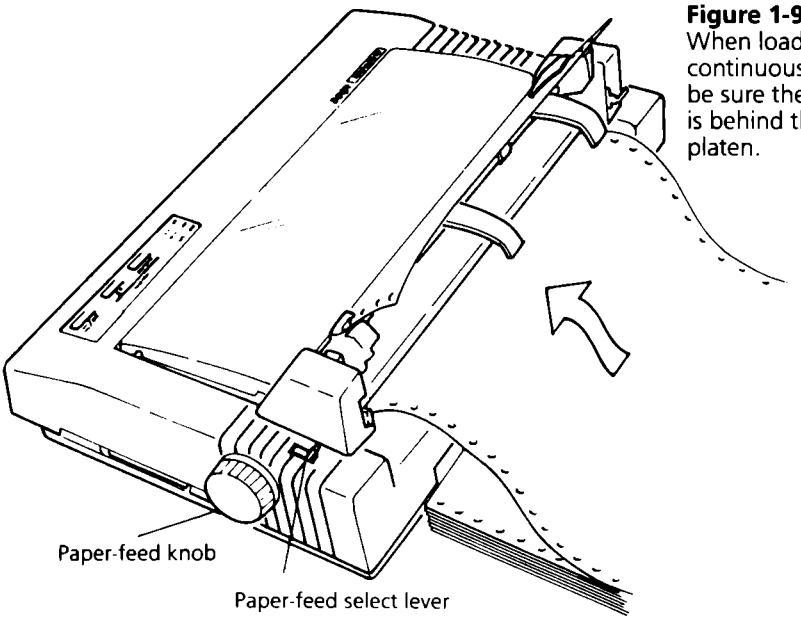
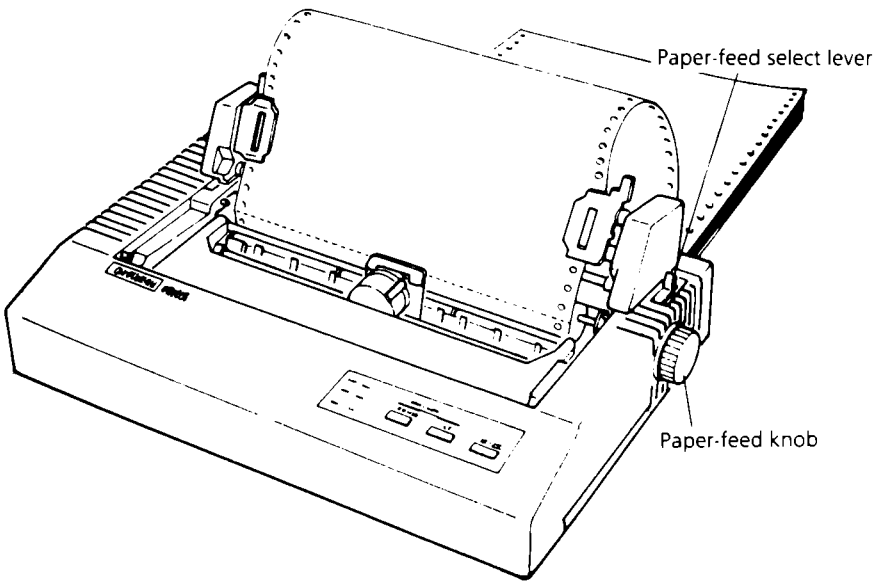


Figure 1-9. When loading continuous paper, be sure the paper is behind the platen.

6. Turn the paper feed knob until the paper advances past the metal ribbon guide. Move the paper select lever back (so that it lines up with the "PIN" label on the side of the tractor-feed mechanism).
7. Fit the punched holes of the paper over the sprocket pins, moving the tractors as needed to accommodate the paper width. Close the tractor covers.
8. Turn the paper feed knob again, lining up the top of the page (or the perforation line) with the top of the ribbon guide (Figure 1-10). This will ensure that you always start printing at the same place on the page.

Figure 1-10. Align the top of the paper with the print head and replace the printer cover.

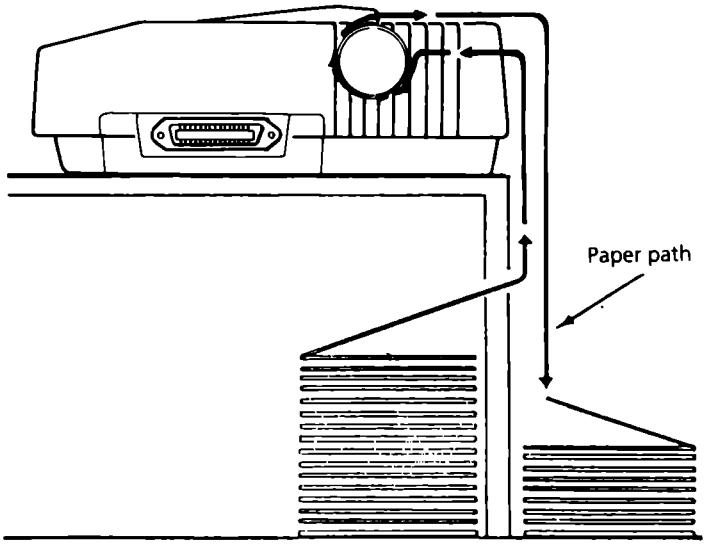


9. Adjust the paper left or right as needed by sliding the tractors. When the paper is positioned (usually with the left edge aligned with the print head), lock the tractors in place by flipping the locking levers towards the back.
10. Replace the printer cover. When you close the cover, it will fit into the front of the tractor unit. Turn the power switch on if you are ready to start printing.

The positioning of the feed paper stack and the printed output is important for smooth operation with continuous paper. The feed paper stack may be placed either behind or below the printer but must not interfere with the flow of printed output.

Wherever it is placed, the stack must be positioned so that the paper feeds in a straight line. If the stack is slightly askew or off centre, it can cause the paper to misfeed. A typical set up for high-volume printing is shown in Figure 1-11.

Figure 1-11.
A typical paper set up for printing with continuous paper.



Bottom-feeding continuous paper

Bottom-feeding continuous paper is useful when you use a printer stand that lets you place a stack of paper under the stand. However, the paper still must flow freely or it will misfeed.

Loading bottom-feed paper is very similar to loading paper into the rear of the printer. With the tractor-feed mechanism installed, simply follow the steps described above, but load the paper into the bottom slot of the printer instead of the rear. When you turn the paper feed knob, the paper feeds from the bottom of the printer around the front of the platen (see Figure 1-12).

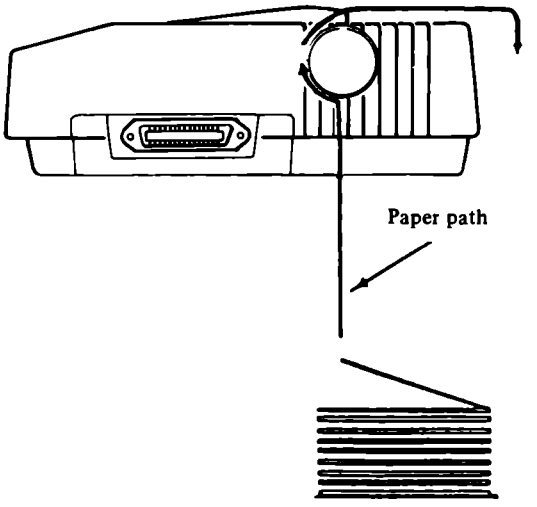


Figure 1-12. Bottom-feed paper is used when you use a printer stand.

Paper thickness

The 120D+ printer is capable of printing up to one original and two duplicate copies using carbonless paper. To print multiple copies, the print head must be adjusted to allow for the extra thickness of the paper. The *paper thickness lever* makes this adjustment.

It is located just in front of the platen, to the right, as shown in Figure 1-13.

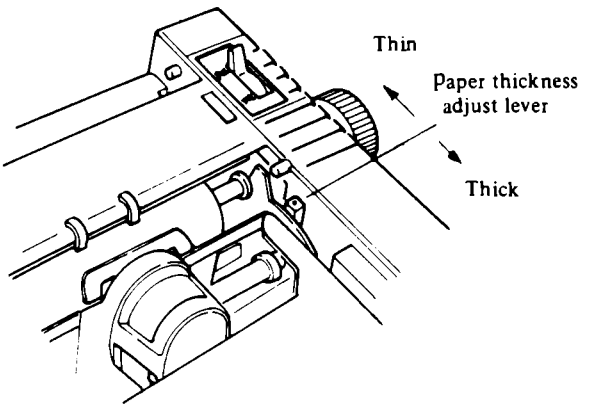


Figure 1-13. The paper thickness lever.

The paper thickness lever has five positions. For most applications, you can leave it at the second position from the narrowest gap between the print head and the platen, as set at the factory. To adjust for multiple copies, move the lever towards the front of the printer. If the print seems too light, move the lever (towards the rear of the printer) to a lower numbered setting.

You should not have to adjust for paper thickness often. If you experiment a little with the self-test in the next section, you can find the setting that is best for your paper.

THE PRINTER SELF-TEST

The 120D+ printer contains a built-in program called a *self-test* that prints all of the 120D+ printer's characters. The self- test assures you that everything is working correctly (including the installation of the ribbon and paper, and the thickness adjustment). And it gives you a preview of what your actual printing will look like.

Running the self-test is very easy and you can even do it without being hooked up to your computer. With paper loaded into the printer and the power switch off, plug the power cord into an electrical outlet. Then, while holding down the LF switch, turn on the power switch.

The result is a print-out of the 120D+ printer's characters — at 120 characters per second! The 120D+ printer has a large repertoire of characters and you'll have to let it go for two pages or more to see them all. If you want to interrupt the self-test, press the on-line switch. To resume, press the on-line switch again.

The self-test prints either the Epson FX/LX character set or the IBM Graphics Printer character set, depending on the configuration selected with internal switches 2 and 3 (see Appendix D for details). Figure 1-14 is a sample of the 120D+ printer self-test in both Epson FX/LX and IBM Graphics Printer configurations.

Epson FX/LX configuration:

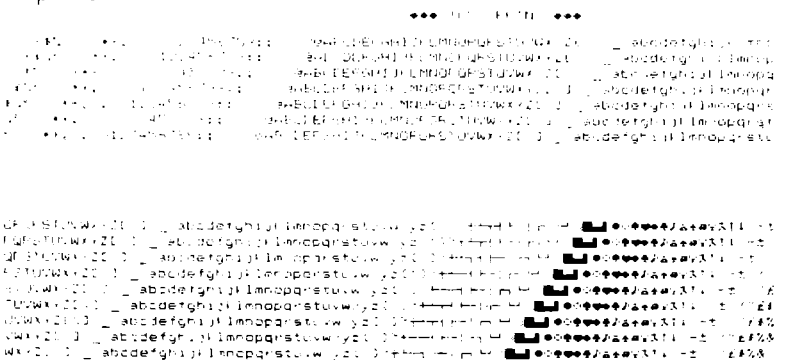
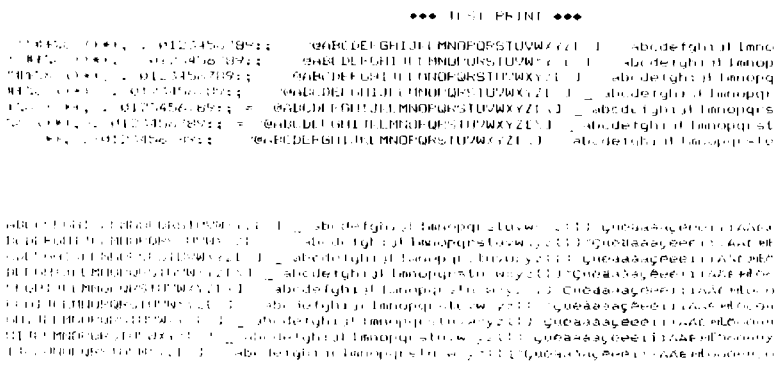


Figure 1-14.
The 120D+ printer self-test.

IBM Graphics printer configuration:



When you are satisfied that everything is working as it should, turn the power switch off to stop the test.

The maintenance self-test

The 120D+ printer has another self-test that is called a maintenance self-test. The maintenance self-test is run by turning the power on with both the LF and On-line buttons held down.

The print-out is headed 'Configuration Print' and consists of three parts. The first part identifies the version of the control program and character generators in your 120D+ printer. Then the print-out describes the setting of the dipswitch controlling the configuration of the printer and finally changes to rows and rows of H's which are used in the factory to check the printing alignment.

To suspend printing in self test operate the ON LINE button and when you wish to leave this mode turn off the power switch.

CONNECTING YOUR COMPUTER

Your computer and printer communicate by means of a cable, which is usually sold separately. Each computer uses a slightly different cable so you will need one made specifically for your computer. The cable you need is called a *Centronics parallel printer cable* or a *parallel printer interface cable.*

NOTE: An optional serial interface is available for the 120D+ printer if your computer does not have a parallel output connection.

WARNING: Before making any connections, be sure that the power is off to both the computer and the printer.

Connecting the cable to the 120D+ printer is very simple. Figure 1-15 shows the cable connector on the right side of the 120D+ printer. The connector is tapered so that you can only connect the cable one way. Move the small wire clamps out of the way and fit the cable connector onto the connector on the 120D+ printer. The two should fit together with just a slight push. (If they do not, turn the cable connector over and try again.) With the cable connected, press the wire clamps into the notches.

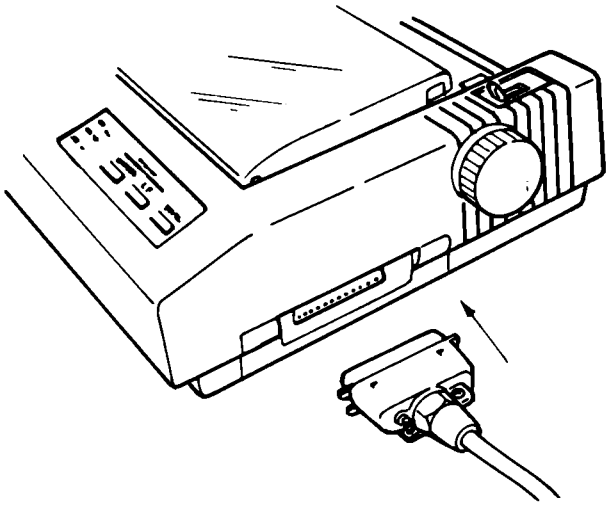


Figure 1-15. Connecting the 120D+ printer to your computer.

Connecting the cable at the computer is different for each computer. The connection may be similar to the one at the printer or it may be inside the computer. Follow the instructions for a parallel printer connection supplied with your computer.

The following are some pointers for various computers. If in doubt, please contact your dealer for advice.

IBM PC and Compatible Computers

You will require a standard IBM centronics cable to connect to the 120D+ parallel interface.

To connect the 120D+ to your IBM using the serial RS232 port you require a standard IBM RS232 cable.

Amstrad Computers

For the Amstrad PC 1512 use the guidelines in the IBM PC and compatible section. For other Amstrad computers, such as the CPC series, you may require a cable with pin 14 disconnected. This is to prevent an extra line feed being sent after each line.

Apple Computers

For the Apple IIc you will require a special parallel cable and may also have to set the computer to 7 bit mode otherwise all your printing will be in italics. For other Apple computers you will require a suitable cable and interface.

Atari Computers

For the ST series and similar Atari computers you can connect your 120D+ printer using a special IBM type centronics cable. For other Atari computers you may require a suitable convertor on your computer and a serial RS232 interface for your 120D+ printer.

BBC Computers

The BBC Master computer can be connected to your 120D+ using a special parallel cable. You may also have to set default switch 1 ON on the 120D+ because the BBC does not automatically send line feeds.

Commodore Computers

You will require a special convertor on your Commodore computer to convert it's output to a suitable parallel or serial format.

Sinclair Computers

You will require a special convertor on your Sinclair computer to convert it's output to a suitable parallel or serial format.

INTERNAL SWITCHES

The 120D+ printer has several *internal switches* located on the interface connector. The connector is actually a cartridge that slides in and out of the right side of the printer. These internal switches customise the 120D+ for particular applications. These switches are set at the factory to work with most computers, and it is most likely that you will not have to adjust them to begin.

As you become more proficient, however, you may want to make some changes. Some of the settings you can change are:

- Printing of graphics and accented characters
- Page length
- Slashed zeros
- Line spacing
- Standard and compressed pitch
- Character font style

As you will see later, most of these functions can also be set using software commands; the switches merely control the way the 120D+ printer operates when you first turn it on.

Appendix D shows you how to remove and replace the interface cartridge, how to change the internal switches, and what printer functions the settings control.

NOTE: The setting of one switch is important for some computers. For computers that do not send a line feed with a carriage return (TRS-80, Atari, and Commodore, for example), switch 1 should be set ON. See Appendix D.

In addition, there is one switch you will have to change if you want your 120D+ printer to act like an IBM graphics printer all the time. Switches 2 and 3 determine if the 120D+ printer acts like an Epson FX/LX printer or an IBM Graphics Printer. It is set at the factory to make the 120D+ printer act like an Epson FX/LX printer. If you want the 120D+ to act like an IBM graphics printer see Appendix D. If you are not sure which kind of printer you want, read Chapter 2. It will help you to decide.

CHAPTER 2
PRINTER BASICS:
USING COMMERCIAL SOFTWARE

In this chapter, we will cover how to use the 120D+ printer with commercial programs, starting with a discussion of how dot matrix printers work and how they use ASCII codes to communicate with computers. Then we'll cover how to use the 120D+ with word processors, spreadsheets and database programs.

DOT MATRIX PRINTING

The 120D+ is called a "dot matrix" printer because each character is printed as a group, or matrix, of dots. If you look very closely at the printed characters you can see the dots. Figure 2-1 shows how the letter H is formed from 17 dots. The print head in the 120D+ consists of a stack of nine pins placed one above the other as shown in Figure 2-2. When the 120D+ receives a signal from the computer, certain pins in the print head strike the ribbon, creating a vertical column of dots on the paper.

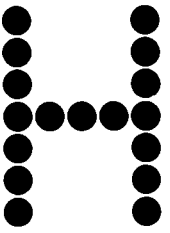


Figure 2-1.
The letter H is formed by 17 dots.

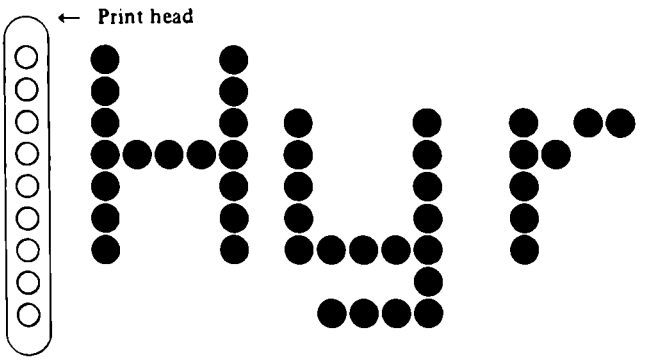


Figure 2-2
The print head has nine pins.

The print head then shifts slightly, and continues to print columns of dots until the letter is formed. As the print head moves across the page, a line of characters is printed.

Then it reverses direction and prints another line of characters as it returns. This process is called *bidirectional* printing.

The correct sequence of strikes and movement of the print head for each character is stored in the printer's memory. The printer selects the character pattern you want based on a numercial code it receives from your computer. These codes are part of a set that is used throughout the computer industry. It is known as the *American Standard Code for Information Interchange*, or ASCII (pronounced ask-key).

ASCII CODES

Most of the time you don't need to be concerned about ASCII codes. When you type a letter A on your keyboard, the computer knows which ASCII code to send to the printer. But if you want to send a non-printing code to your printer, to change to compressed print for example, you need to know the ASCII code and how to get your computer to send it.

There are 256 ASCII codes, numbered 0 to 255. The first 128 include the codes for the letters of the alphabet (both lower and upper case), the digits 0 to 9, and punctuation marks. For example, the letter A is ASCII 65; the digit 6 is ASCII 54. The first 128 ASCII codes also contain a number of non-printing codes, called *control codes*. These codes, ASCII 0 through to 31, are the ones that control the 120D+'s functions.

The second 128 codes, ASCII 128 to 255, are sometimes called the "high-bit" or "8-bit" ASCII characters. They are less standardised than the first 128 and their meaning depends somewhat on the particular equipment and application involved. The 120D+ interprets the high-bit ASCII codes as italic characters, graphic characters, and special symbols.

There are two numbering systems for ASCII codes. Some books and programs refer to them by their decimal value (0 to 255) and others use their hexadecimal value.

Hexadecimal numbers

The numbers we usually use are called *decimal* numbers because they are based on ten — the ten digits 0 through to 9. *Hexadecimal* numbers, or hex numbers for short, are based on 16 — the ten digits 0 through to 9 and the six letters A through to F. To distinguish them from decimal numbers, hex numbers are usually written in one of three ways:

1. followed by an h (e.g. 13h or 6Ah)
2. preceded by an ampersand and H (e.g. & H13 or & H6A)
3. preceded by a dollar sign (e.g. $13 or $6A).

All have the same meaning; it depends on which book you are reading. In this book, we use the first style; hex numbers are followed by an h as in 6Ah.

The ASCII codes in hexadecimal are OOh to FFh. Whether you use decimal or hexadecimal ASCII codes depends on your computer system and which software program you are using. Appendix B contains a complete list of all the ASCII codes with their decimal and hex values.

NON-PRINTING CODES

Many of the ASCII codes used with the 120D+ are the non-printing, or control codes, ASCII 0 to 31. The most frequently used code of all is ASCII 27, which is known as the *escape code*, or simply ESC. It is used in combination with other codes to control almost all of the 120D+ features. In BASIC, the escape code is CHR$(27). We are going to refer to it as ESC in the text of this book.

How you enter a non-printing ASCII code on your keyboard depends on the program you are using. One very common method is the function CHR$. CHR$(n) is actually a BASIC function. It tells the computer that you want the character whose decimal ASCII code is n. For example, you can type CHR$(15) and your computer will know you want ASCII code 15 which produces compressed print on the 120D+.

Commercial programs use a variety of methods to enter non-printing codes and send them to the printer. Some of the more popular methods are discussed in the next sections.

PRINTER INSTALLATION

The 120D+ is compatible with most commercial programs — word processors, spreadsheets and database programs. Before you can see some printing, however, most programs require that you "install" your printer, that is, tell your program what kind of printer you have.

Choosing the right configuration

This is where the question of which way you want your 120D+ configured (IBM-compatible or Epson-compatible) needs to be answered. Let's look at the differences between the two configurations.

The differences between the two configurations are not great. First, there are a few of the control codes, which are instructions from your computer to the 120D+, that work differently in the two configurations. Also, while the standard characters stay the same, many of the special characters that the 120D+ can print are different in the two configurations.

Generally, if your computer is an IBM-PC, a close relative, or a compatible, you probably want your 120D+ configured as an IBM Graphics Printer. Almost all software written for the IBM-PC market supports the IBM Graphics Printer, and this configuration gives you the same character set as the IBM-PC computer.

If your computer doesn't try to imitate an IBM-PC, then you should probably select the Epson FX/LX configuration. Epson printers are widely supported by nearly all software in the microcomputer world.

Whichever configuration you choose, you don't miss any of the features of the 120D+. It's actually easy to switch back and forth between the two configurations "on-the-fly" with a simple command from your computer. We'll show you how to use that command in Chapter 4.

Software printer choices

Many programs, especially those on word processors, include an installation routine for your printer. Typically, the installation routine gives you a choice of several printers or printer types. It may also ask some questions about backspacing, line feeds, and form feeds.

Any of the following printer choices will work for the 120D+. "Epson printer", "TTY-type printer with backspace", "ASCII dot matrix printer", "IBM Graphics Printer". Selecting one of these options should do the trick.

Some programs need more information about your printer, however. If your program wants to know, the 120D+ printer:

- uses the list output driver (LST: or LPT1:)
- uses no communications protocol
- does not require a printer initialisation string (for normal 80-column printing)
- can backspace (ASCII 8)
- can underline (ASCII 95)
- does not do an automatic line feed (unless you change internal switch 1)
- can do a hardware form feed (ASCII 12)

If your program asks other questions, or doesn't have any printer choices that resemble those above, eliminate the choices involving letter quality or daisy-wheel printers (with names like Diablo and Spinwriter) and experiment. The worst that will happen is that you'll get very strange results or no results at all and you can make a different printer choice.

Once you have completed the installation, you are ready to use your new 120D+ printer. Try a short printing sample using your program. You will see what a good choice you made in purchasing the 120D+ printer.

WORD PROCESSORS

Strange as it may seem, the special printing effects built into many word processing programs are limited to boldface and underlining. Fortunately, most programs provide a way to send special codes to the 120D+ to take advantage of its additional capabilities such as italics, font select, compressed and extra width print, superscripts and subscript, graphics characters and so on. But it takes a little manoeuvring.

The trick is to get your word processing program to place the necessary non-printing codes into your text file and send them on to the printer without interpreting them as its own commands. With the notable exception of WordStar, most word processing programs allow you to do this by providing a special "literal" character. (If you are using WordStar, check your Installation Manual for the details about using "print control codes" to access the 120D+'s print features.

Literal characters

A "literal" character tells the word processing program that the character following it is to be accepted literally (placed in the text file as is) and not interpreted as a word processing command. The literal character in many word processing programs is itself a particular non-printing control character. Other programs, such as Microsoft Word and Framework make use of the ALT key. Still others use the ESCape key. Check your word processor's user manual to see how to insert non-printing codes into your file.

For example, to select emphasised print, you must send the code ESCape E to the 120D+. To enter ESC E into your text file, key your word processor's literal character, ESC and then E. It doesn't matter how this sequence shows on your screen; when you print the file, the 120D+ will get the message that you want emphasised print.

SPREADSHEETS, DATABASES AND OTHER PROGRAMS

Most of these programs provide a set up option in their output or print mode that asks you to make two settings for your printer: the number of characters per line, and the codes to be sent to the printer at the start of printing, called the "printer initialisation string".

The two settings are related. The number of characters per line depends on the print mode, which is determined by the initialisation string you send. Table 2-1 shows printer initialisation strings for some common print modes.

TABLE 2-1. PRINTER INITIALISATION STRINGS

Print mode	Characters per line	Initialisation string
10-pitch	80	none
12-pitch high speed	96	ESC M
Compressed	136	CHR$(15)*
Compressed high speed	160	ESC M CHR$(15)*

(The Compressed high speed mode is available in Epson configuration only.)

* If you plan to use your printer mostly for financial applications, you may want to set the internal switches so that compressed mode is automatically selected when the 120D+ is turned on (see Appendix D). If you make this change, the initialisation string for compressed print is not needed when your send your output to the printer.

CHAPTER 3
USING BASIC

If you are not using a commercial program, you must use a programming language to communicate with the 120D+ printer. Since BASIC is the most popular programming language, it is one we have used in this manual to demonstrate the features of the 120D+. However, the 120D+ works just as well with other high-level languages, such as C or Pascal. Simply send the same ASCII codes with whatever print statements your language uses.

This chapter is an introduction to programming with the 120D+. In it we look at the characteristics of some major brands of computers and how their different versions of BASIC communicate with a printer. We suggest that you start with the first section on the versions of BASIC. Then read the section pertaining to your computer to learn what changes you'll need to make the example programs in the following chapters work on your computer. When you are finished skip to the end of the chapter to the sections on listing a program and escape codes.

WHICH BASIC?

Although BASIC is the most common programming language for personal computers, different computers use slightly different versions of the language. And, unfortunately, the biggest way these versions differ is in how they send information to the printer.

The most common version of BASIC is the one developed by Microsoft Corporation. It is used by Radio Shack, IBM, IBM-compatible, and most CP/M computers.

NOTE: Strictly speaking, MBASIC, TRS-80 BASIC, and IBM BASIC are not the same. However, the differences are very slight and, for our purposes, we will treat them as one. Where the differences matter, we will tell you.

Microsoft BASIC uses an L before the PRINT and LIST commands to direct the output to the printer (for example, LPRINT, LLIST). Other BASICs treat the printer as an output file or port and use plain PRINT commands redirected to that output.

Another difference in BASIC versions is the way certain ASCII control codes are handled. Many computers change some ASCII codes when they send them to the printer. The ASCII codes for a horizontal tab (CHR$(9)), carriage return (CRH$(13)), and line feed (CHR$(10)) are often changed, as are the high-bit ASCII codes 128 to 255.

Because Microsoft BASIC is used by more computers than any other, we will use it in our examples. If your computer does not use MBASIC (or IBM BASIC or GW BASIC), you may have to modify the example programs to suit your version of BASIC.

Read the section that follows pertaining to your computer to see what modifications to make.

IBM and compatible computers

All the example programs in this manual are written in the BASIC used by IBM-compatible computers and you should not have to modify them. The only thing you need to be aware of is that most of these computers automatically insert a carriage return and line feed after 80 characters. To avoid this when printing graphics, set the line width of the printer to 255 by adding the statement WIDTH "LPTI:", 255 or WIDTH LPRINT 255. Also remember that a line feed is added with every CHR$(13). If you use CHR$(13) in a graphics program, you can avoid unwanted line feeds in the middle of your graphics image by treating the printer as a random file and using PRINT# statements instead of LPRINT statements:

```
10 OPEN, "LPT1:" AS #1
20 WIDTH #1, 255
30 PRINT #1, "RANDOM FILE PRINTING"
```

Apple II computers

Applesoft BASIC does not use LPRINT and LLIST commands. Instead, Applesoft uses a PR# command to send the output to the printer instead of the screen. Modify the sample programs by changing LPRINT to PRINT and adding the Applesoft PR#1 (substitute your printer slot, if not in slot 1) command to direct the output of the PRINT statements to the printer.

Depending on the particular version of Applesoft you are using, add the statement PR#1 or PRINT CHR$(4) "PR#1" at the beginning of the program. To return output to the screen add PR#0 or PRINT (CHR$(4) "PR#0" at the end of the program.

```
10 PR#1
20 PRINT "APPLE PRINT STATEMENT"
30 PR#0
```

To print lines longer than 40 or 80 columns add the statement PRINT CHR$(9) "255N". This allows lines up to 255 characters to be sent to the printer. It is especially important for graphics and compressed print.

Listing a program on an Apple follows the same procedure. Use a PR#1 command to direct the listing to the printer and PR#0 to return output to the screen when the listing is finished.

```
PR#1
LIST
PR#0
```

When you try the example programs in this manual, you will find two ASCII codes that are problems with Applesoft. They are ASCII codes 9 and 13.

In Applesoft, CHR$(9) or CTRL I is used to initialise the printer interface. This code and one or more codes following it are intercepted by the interface and never sent to the printer; CHR$(9), however, is the 120D + 's horizontal tab code.

To bypass this problem, you can change the printer initialisation code to another value. For example:

```
PR#1
PRINT CHR$(9); CHR$(26)
```

makes CHR$(26), or CTRL Z, the printer initialisation code. You will then not be able to send CHR$(26) to the printer, but that code is rarely used anyway.

CHR$(13) is the code for a carriage return. It is a problem when used in graphics because the Apple automatically sends a line feed, CHR$(10), with each carriage return. It is a good idea to avoid using CHR$(13) in graphics programs.

If you want to get fancy, you can solve both of these problems by poking the codes directly to the printer output port. For example, this routine will send CHR$(9) to the printer:

```
100 IF PEEK(46901) > 127 GOTO 100
110 POKE 49296,9
```

Line 100 is necessary to make sure the printer is ready to receive the data. Substitute the code you want for 9 in line 110.

One last difficulty with the Apple concerns the high-bit ASCII codes 128 through to 255. The Apple printer interface subtracts 128 from these codes before it sends them to the printer. This limits your options if you want to use the 120D+'s italic or graphic characters.

Fortunately, the 120D+ has a way around this limitation. Sending the command ESC>(CHR$(27)">") to the 120D+ tells it to use the high-bit ASCII codes no matter what code it receives from the computer. In a sense, the 120D+ adds back the 128 that the interface card subtracts. If you're a programmer, it sets the high-order bit. For example, to print an italic A, you can use the following:

```
10 PR#1
20 PRINT CHR$(27) ">"
30 PRINT CHR$(65)
```

Line 20 tells the 120D+ to add 128 to all the ASCII codes it receives. It thus prints CHR$(193), an italic A.

When you want to return to roman print, you must cancel the high-bit setting with an ESC # code. See the explanation of ESC > and ESC # in Chapter 9.

Amstrad Computers

When using an Amstrad 1512 PC you can use the Basic programs listed in the manual without modifications.

If you are using an Amstrad CPC series computer you will need to replace the LPRINT statements in the sample programs with PRINT#8.

TRS-80 computers

If you are using a Model II you must initialise your system with the FORMS command to send statements to the printer.

The only modifications to make to the example programs concern the ASCII codes 0, 10, 11 and 12. Radio Shack computers do not pass any of these codes to the printer properly. To use these codes you must bypass BASIC and send them directly to the printer port. For example, use the following statements to send CHR$(12):

```
100 IF PEEK (14312) <> 63 THEN 100
110 POKE 14312,12
```

Substitute the decimal ASCII value for the code you wish to send for the value 12 in line 110. Line 100 checks to see if the printer is ready to receive data.

CP/M computers

Most CP/M computers (including Kaypro, Osborne, Morrow, Sanyo, and Apple with a CP/M card) use MBASIC. The example programs therefore need very little modification for these computers.

There are, however, two things to be aware of. Some of these computers change CHR$(9) to a group of spaces to simulate a horizontal tab. To send a horizontal tab to the 120D+ with these computers, use the high-bit ASCII tab value CHR$(137) instead.

Some computers also add a carriage return and line feed every 80 characters. Add the statement WIDTH LPRINT 255 to the example programs to prevent these unwanted codes.

Atari computers

Atari BASIC has some unique characteristics to keep in mind. It requires that all strings be dimensioned and the maximum string length is 99 characters as opposed to 255 in other BASICs. Therefore, when using graphics you will have to break up strings into 99 character sections and join them together with a statement such as A$(LEN(A$)+1)=B$, which adds the string B$, to the end of A$.

Because Atari BASIC adds spaces to print lines when you use LPRINT, it is best to use the PRINT# command instead. Add a line to the example programs to open the printer as a device first and then change the LPRINT statements to PRINT# statements. For example:

```
10 OPEN #4,8,0,"P:"
20 PRINT #4,"ATARI PRINT STATEMENT"
```

Add a statement like CLOSE #4 at the end of the program to close the printer as a device.

Atari BASIC requires semicolons between elements in a print statement. Change the print statements in the example programs to this format:

```
PRINT #4; CHR$(27); "B"; CHR$(3)
```

Atari BASIC does not use the LLIST command to list programs. To list a program use the statement LIST "P:".

Using the Atari ST computers with GEMBASIC you can use the sample programs included in this manual without modification.

Commodore computers

Commodore BASIC does not use the LPRINT statement. Instead, you must open the printer as a file and direct the print statements to that file. Add a statement at the beginning of the example programs such as OPEN 4,4 to open the printer as a file. Then change the LPRINT statements to PRINT# statements. For example:

```
10 OPEN 4,4
20 PRINT#4, "COMMODORE PRINT STATEMENT"
```

Add a statement to clear the buffer and close the file at the end of the example programs, such as :

```
PRINT#4   CLOSE 4.
```

Listing a program on Commodore computers requires a similar procedure. Open the printer as a file and direct output to the printer. Then issue a LIST command.

```
OPEN 4,4
CMD 4
LIST
```

At the end of the program close the printer file to return output to the screen with a statement like:

```
PRINT#4   CLOSE 4
```

BBC computer

The BBC computers do not send an automatic line feed with a carriage return and so this must be provided. There are two ways of doing this:

1. Insert the command * FX6,0 at the start of your programs. This will send a line feed with each carriage return sent.
2. If default switch 1 is set ON, the 120D+ will add a line feed to each carriage return sent.

The sample programs included in this manual must be modified to suit the BASIC available on BBC computers.

This requires the use of these commands:

1. VDU 2. This command enables the printer allowing it to receive data. It must be sent before sending any data to the printer.

2. VDU 3. This command disables the printer e.g. Use the following program to demonstrate the use of VDU 2 and VDU 3.

```
10 PRINT "THIS IS THE FIRST LINE"
20 VDU 2
30 PRINT "THIS IS THE THIRD LINE"
40 VDU 3
50 PRINT "THIS IS THE FIFTH LINE"
```

When you run this program the screen will show

THIS IS THE FIRST LINE
THIS IS THE THIRD LINE
THIS IS THE FIFTH LINE

But the printer will only show

THIS IS THE THIRD LINE

If you wish to list a program then send VDU 2 to the printer followed by LIST.

3. VDU 1 This command sends data to the printer alone and is the equivalent to the LPRINT command in Microsoft Basic. e.g. To set the 120D+ into NLQ mode:

Command to turn NLQ on is ESC x 1. Replace command with ASCII equivalent 27 120 1. Command is VDU 1, 27, 1, 120, 1, 1.

Try the following program.

```
10 VDU 1, 27, 1, 120, 1, 0
20 VDU 2
30 PRINT "THIS LINE IS DRAFT"
40 VDU 1, 27, 1, 120, 1, 1
50 PRINT "THIS LINE IS NLQ"
60 VDU 3
```

LISTING A PROGRAM

One of the simplest things you can do with BASIC is list a program on your printer. To make sure you know how to activate the 120D+ with your computer's BASIC, let's print a program listing.

Load a program into your computer's memory. (If you are not sure how to do this, check the user's manual for your computer's BASIC. Most computers use a simple command like LOAD followed by the program name.)

To LIST the program on the 120D+, use the command LLIST if you are using Microsoft BASIC or use whatever routine is necessary for your computer. Check the previous section on your computer if you are not sure what method to use.

THE ESCAPE CODE

Many of the 120D+'s features are controlled with an escape code sequence — a group of several ASCII codes that begins with the character called escape or ESC. Escape is ASCII 27 or CHR$(27). It is the ASCII code you will use more than any other with the 120D+.

As an example, type the following line while in Epson mode and then list your program again. (Remember to change LPRINT to whatever your system requires.)

```
LPRINT CHR$(27); CHR$(77)
```

Your program listing will now be printed in high-speed 12-pitch print.

Did you realise that CHR$(77) is the same as the letter M? We could just as easily have typed:

```
LPRINT CHR$(27); "M"
```

The 120D+ will understand either version and respond by turning on high-speed mode.

Because ESC is used so often, many programmers define CHR$(27) as a string variable in their programs with an assignment statement. To turn on 12 pitch mode, for example, you could use:

```
10 ESC$ = CHR$(27)
20 LPRINT ESC$ + "M"
```

ESC$ is much shorter to type than CHR$(27). Adding one assignment statement at the beginning of a long program can save a lot of typing.

Now reset the 120D+ to 10-pitch by switching the power off and on before you move on, unless you want to continue printing in 12-pitch.

INITIALISING THE PRINTER

When you *initialise* the 120D+ printer, you clear any special settings you have made and return the printer to the settings specified by the current internal switch settings and the Read Only Memory (ROM) of the printer.

There are three ways to initialise the printer:

1. By turning the power switch OFF, then ON again.
2. When the INIT signal goes LOW on the parallel interface.
3. By sending the software command ESC @. (Epson configuration). Many application programmes use this command, however, some settings you may not wish to lose are those set from the front panel. Your 120D+ will therefore retain these settings.

Table 3-1 shows you what happens during initialisation:

TABLE 3-1. PRINTER INITIALISATION SETTINGS

Setting	Description
Print head	Returned to the home position (the extreme left)
On-line status	Place on line, unless out of paper
Print buffer	Cleared, including download characters
Margins	All margins are cleared
Tab settings	All tab settings are cleared; horizontal tabs are set at every eight columns
Character pitch	10 characters per inch, or set by switch 7 in Epson 2 configurations*
Line spacing	1/6 inch, or set by switch 5 in IBM 1 configuration*
Page length	11 inches, or set by switch 7 and 8 in Epson 1 and IBM 2 configuration*
Top of form	Current paper position
Switch settings	Records current settings
Font Style	Character font style 1 or set by switch 8 in IBM 1 or Epson 2 configuration.

* For details concerning internal switch settings, refer to Appendix D.

In this manual, the term *power on default values,* or simply *defaults,* are those set by initialisation.

CHAPTER 4
PRINTING TEXT

Starting with this chapter we will look at each of the 120D+'s commands in detail — what the command does, how it works, and how to use it. Example programs, written in Microsoft BASIC, will show you how to send commands to the 120D+ printer. If your computer does not use Microsoft BASIC, you should modify the programs for your computer as discussed in Chapter 3.

NOTE: So that your sample programs come out the same as ours, we assume that you have configured your 120D+ as an Epson printer (see Appendix D for Epson configuration options).

This chapter covers the commands that control the way the 120D+ prints text. Included are commands that let you select correspondence quality print and proportional spacing, change the pitch, character width and character height.

There are commands that let you select emphasised and doublestrike print, italic, underlining, reverse print, and superscripts and subscripts. The last part of this chapter covers commands that let you change pitch, font or print mode with just one command. Finally, the commands used to print special characters and symbols are covered.

By using the commands in this chapter, you'll be able to customise your text printing exactly to your taste and needs.

NEAR LETTER QUALITY

Format:	**ON**	**OFF**
BASIC	CHR$(27) "x1"	CHR$(27) "x0"
Hex	1B 78 01	1B 78 00

Near letter quality printing (NLQ) uses a special character set very similar to the type on a typewriter or letter-quality printer, which can be used for finished correspondence and final reports.

ESC "x1" turns on near letter quality printing; ESC "x0" turns it off and returns to standard print (the x must be lower case). Since the 1 and the 0 work as on and off switches rather than actual characters, you can substitute CHR$(1) and CHR$(0) for their actual ASCII codes if you like.

Near letter quality prints each line twice and is therefore somewhat slower than standard draft print. If you're printing a longer document, the slower speed can make a difference. You might want to use draft print for your preliminary drafts and save near letter quality for your finished copies.

Near letter quality is compatible with most of the 120D+'s features. You may use near letter quality with pica, elite, expanded, emphasised and italic print, but not with reverse print.

Example:

```
5       WIDTH LPRINT 40
10      FOR N = 32 TO 126: A$ = A$ + CHR$(N): NEXT
20      LPRINT CHR$(27); "x1"; "NEAR LETTER QUALITY"
30      LPRINT A$: LPRINT
40      LPRINT CHR$(27); "x0"; "STANDARD MODE"
50      LPRINT A$
```

```
NEAR LETTER QUALITY
 !"£$%&'()*+,-./0123456789:;<=>?@ABCDEFG
HIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmno
pqrstuvwxyz{|}~

STANDARD MODE
 !"£$%&'()*+,-./0123456789:;<=>?@ABCDEFG
HIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmno
pqrstuvwxyz{|}~
```

In the IBM configuration, you can also select near letter quality with the following format:

BASIC	CHR$(27) "I" CHR$(n)	(n = 0, 2, 4)
Hex	1B49 nh	(nh = 00h, 02h, 04h)

This sequence selects the printing quality.
- When n = 0, you have normal quality (draft font).
- When n = 2, you have a correspondence quality (NLQ) (standard font).
- When n = 4, you have normal quality (download font).
- When n = 6, you have emphasised quality (download font).

Each printing quality selection produces a different spacing of the dots that make up a character. Use ESC = to load a download font, before you select the print quality (with either ESC I;(4); or ESC I;(6);). Please refer to Chapter 8; creating characters.

CHARACTER PRINT WIDTH

The 120D+ has three ways of changing the width of a printed character: changing the basic pitch, expanding the characters, and compressing the characters. By combining these three methods, the 120D+ can print eight different character widths, as shown in Table 4-1.

TABLE 4-1. CHARACTER WIDTHS.

Character width	Characters per inch	Maximum characters per line
Pica standard	10	80
Pica expanded	5	40
Pica compressed	17	136
Pica compressed expanded	8.5	68
Elite standard	12	96
Elite expanded	6	48
Elite compressed	20	160
Elite compressed expanded	10	80

Character pitch
The *character pitch* tells you how many characters will be printed in one inch. It is another term for characters per inch, or cpi. The 120D+ is capable of two basic pitches: 10-pitch, sometimes called pica, and 12-pitch, sometimes called elite. They are described below.

Pica pitch

Format:	ON	OFF
BASIC	CHR$(27) "P"	CHR$(27) "M"
Hex	1B 50	1B 4D

This command turns on pica which prints 10 characters per inch. Pica pitch is the power-on default with internal switch 7 on in the Epson 2 configuration (see Appendix C). Pica pitch does not cancel other character width commands in effect such as expanded or compressed print and is turned off by selecting the other pitch command, which is elite pitch, ESC M. Pica pitch can also be set with ESC ~3 and ESC !. ESC M, ESC ~3 and ESC ! set high-speed elite mode.

Table 4-1 shows the character widths possible using pica pitch.

Example:

```
10      LPRINT CHR$(27); "P";
20      LPRINT "THIS LINE IS IN 10 PITCH PICA"

THIS LINE IS IN 10 PITCH PICA
```

Elite pitch and High-speed mode

Format:	ON	OFF
BASIC	CHR$(27) "M"	CHR$(27) "P"
Hex	1B 4D	1B 50

This command turns on high-speed elite mode which prints 12 characters per inch. Elite pitch does not cancel other character width commands in effect such as expanded or compressed print and is turned off by selecting pica pitch with ESC P. Table 4-1 shows the character widths possible using elite pitch.

High-speed Elite mode can also be selected with ESC ~3 and ESC! in both the Epson and IBM Graphics Printer configurations. In the IBM configuration, you can also select high-speed elite mode with ESC:

Format:	High-speed Elite	Normal Elite
BASIC	CHR$(27) "~81"	CHR$(27) "~80"
Hex	1B 7E 38 31	1B 7E 38 30

This command selects high-speed or normal Elite when Elite is selected. (Same for Epson and IBM configurations) i.e. ESC ~8 must be used in conjunction with ESC M, ESC :, ESC ~3 or ESC !

Example:

```
10      LPRINT CHR$(27); "@";
20      LPRINT CHR$(27); "M";
30      LPRINT "ABCD"
40      LPRINT CHR$(27); "~80";
50      LPRINT "EFGH"
60      LPRINT CHR$(27); "~81";
70      LPRINT "IJKL"
```

```
ABCD                                    (High-speed Elite)
EFGH                                    (Normal Elite)
IJKL                                    (High-speed Elite)
```

Example:

```
10      LPRINT CHR$(27); "@";
20      LPRINT CHR$(27); "^B0";
30      LPRINT "ABCD"
40      LPRINT CHR$(27); "M";
50      LPRINT "EFGH"
60      LPRINT CHR$(27); "^81";
70      LPRINT "IJKL"
```

```
ABCD                                    (Pica)
EFGH                                    (Normal Elite)
IJKL                                    (High-speed Elite)
```

Invalid print styles with high-speed Elite mode are reverse print, NLQ and proportional spacing. If these combinations are selected Normal Elite characters are printed with the selected print style.

High-speed Elite is only available with Font 2. Font 2 is automatically printed when high-speed Elite is selected.

Example:

```
WIDTH LPRINT 255
10      LPRINT CHR$(27); "M"
20      LPRINT "COMPARE THIS LINE IN 12 PITCH ELITE"
30      LPRINT CHR$(27); "P"
40      LPRINT "TO THIS LINE IN 10 PITCH PICA": LPRINT
50      LPRINT "YOU CAN ALSO HAVE "; CHR$(27); "M"; CHR$(27); "^B0";
60      LPRINT "BOTH PITCHES IN ONE LINE "; CHR$(27); "P";
70      LPRINT "IF YOU LIKE"
```

```
COMPARE THIS LINE IN 12 PITCH ELITE

TO THIS LINE IN 10 PITCH PICA

YOU CAN ALSO HAVE BOTH PITCHES IN ONE LINE IF YOU LIKE
```

Continuous expanded print

Format:	**ON**	**OFF**
BASIC	CHR$(27) "W1"	CHR$(27) "WO"
Hex	1B 57 01	1B 57 00

In expanded print, characters are printed at twice their normal width. Both characters *and* the spaces are doubled. This means the maximum number of characters per line is cut in half. Table 4-1 shows the character widths possible using expanded print.

The command uses a 1 and 0 as its on and off switches. Using ESC W1 turns on expanded print; ESC WO turns off expanded print. Since the 1 and the 0 work as on and off switches rather than actual characters, you can substitute CHR$(1) and CHR$(0) for their actual ASCII codes, if you like.

Expanded print can also be selected with ESC!

Example:

PICA EXPANDED
UNEXPANDED PICA

ELITE EXPANDED
UNEXPANDED ELITE

```
10      LPRINT CHR$(27); "P"
20      LPRINT CHR$(27); "W1"; "PICA EXPANDED"
30      LPRINT CHR$(27); "W0"; "UNEXPANDED PICA"
40      LPRINT CHR$(27); "M"; CHR$(27); "^80"
50      LPRINT CHR$(27); "W1"; "ELITE EXPANDED"
60      LPRINT CHR$(27); "W0"; "UNEXPANDED ELITE"
```

One-line expanded print

Format:	**ON**	**OFF**
BASIC	CHR$ (14)	CHR$(20)
Hex	OE	14

The command CHR$(14) or ESC CHR$(14) turns on expanded print for one line only. The printer automatically returns to normal print for the next line. One frequent use for expanded print is for headlines and titles. Other than printing only one line, however, this command acts like continuous expanded print, as described above.

If you want only part of a line in expanded print, the command CHR$(20) can be used in mid-line to cancel CHR$(14). You can also cancel one-line expanded set by CHR$(14) with ESC WO. You cannot, however, cancel ESC W1 with a CHR$(20).

Example:

EXPANDED HEADLINE
BACK TO NORMAL AFTER ONE LINE
EXPANDED PRINT HEADLINE
BACK TO NORMAL PRINT AGAIN

```
10      LPRINT CHR$(14); "EXPANDED HEADLINE"
20      LPRINT "BACK TO NORMAL AFTER ONE LINE"
30      LPRINT CHR$(14); "EXPANDED"; CHR$(20); " PRINT ";
40      LPRINT CHR$(14); "HEADLINE"
50      LPRINT "BACK TO NORMAL PRINT AGAIN"
```

Compressed print

Format:	ON	OFF
BASIC	CHR$(15)	CHR$(18)
Hex	OF	12

This command compresses the character width to approximately 60% of the width in effect when the command is sent (both characters and spaces are affected). Compressed print lets you print more characters per line. Compressed pica prints 17 characters per inch.

You can combine compressed and expanded print in combination with pica or elite pitch which results in a character width about 85% of the normal pitch. Table 4-1 shows all the character widths possible using compressed print.

Compressed print can be turned on with either CHR$(15) or ESC CHR$ (15). The command CHR$(18) turns off compressed print and returns you to either pica or elite pitch, whichever you set last.

Examples:

```
10      LPRINT CHR$(27); "P"
20      LPRINT "THIS LINE IS IN STANDARD PICA"
30      LPRINT CHR$(15); "THIS LINE IS IN CONDENSED PICA"
40      LPRINT CHR$(18); CHR$(27); "M"
50      LPRINT "THIS LINE IS IN STANDARD ELITE "
60      LPRINT CHR$(27); CHR$(15);
70      LPRINT "THIS LINE IS IN CONDENSED ELITE"
80      LPRINT CHR$(18); CHR$(27); "P"
90      LPRINT "PICA,"; CHR$(27); "M"; "ELITE,";
100     LPRINT CHR$(27); "P"; CHR$(15); "CONDENSED PICA,";
110     LPRINT CHR$(27); "M"; "AND CONDENSED ELITE ALL ON ONE LINE."
120     LPRINT CHR$(18); CHR$(27); "P"
130     END
```

```
THIS LINE IS IN STANDARD PICA
THIS LINE IS IN CONDENSED PICA

THIS LINE IS IN STANDARD ELITE
THIS LINE IS IN CONDENSED ELITE

PICA, ELITE, CONDENSED PICA, AND CONDENSED ELITE ALL ON ONE LINE.
```

NOTE: The program below demonstrates all eight of the 120D+'s character widths. You may want to save the program and keep the print-out as a guide to the 120D+'s different character widths.

```
10      LPRINT CHR$(27); "p1";
20      GOSUB 100
30      LPRINT CHR$(27); "p0";
40      GOSUB 100
50      END
100     LPRINT "A STEP FORWARD IN READABILITY AND AESTHETICS"
110     LPRINT "COMES WITH ";
120     LPRINT CHR$(27); "4";
130     LPRINT "PROPORTIONAL PRINTING.";
140     LPRINT CHR$(27); "5";
150     LPRINT "WHERE THE"
160     LPRINT "WIDTH EACH CHARACTERS OCCUPIES IS"
170     LPRINT "PROPORTIONAL TO ITS SHAPE"
180     LPRINT
190     RETURN
```

```
130     LPRINT ESC$; "P";
140     LPRINT "CONDENSED EXPANDED PICA:8.5 CPI"
150     LPRINT ESC$; "M"; ESC$; "W0"; CHR$(18)
160     LPRINT "EXPANDED ELITE:6 CPI"
170     LPRINT ESC$; "P";
180     LPRINT "EXPANDED PICA:5 CPI"
190     LPRINT ESC$; "W0"
```

```
CPI=CHARACTERS PER INCH
```

```
CONDENSED ELITE:20 CPI
CONDENSED PICA:17 CPI

STANDARD ELITE:12 CPI
STANDARD PICA:10 CPI

CONDENSED EXPANDED ELITE:10 CPI
CONDENSED EXPANDED PICA:8.5 CPI

EXPANDED ELITE:6 CPI
EXPANDED PICA:5 CPI
```

Proportional print

Format:	ON	OFF
BASIC	CHR$(27) "p1"	CHR$(27) "p0"
Hex	1B 70 01	1B 70 00

With proportional printing, the width each printed character occupies is *proportional* to its shape. For example, an "M" is wider than a "1". (The 120D+'s other print widths have *fixed* widths, that is, each character has the same width.) Proportional characters are always printed in emphasised print and are compatible with all print styles. The command uses a 1 and 0 as its on and off switches. (Using ESC p1 turns on proportional print; ESC p0 turns off proportional print (note that you must use a lower case p). Since the 1 and the 0 work as on and off switches rather than actual characters, you can substitute CHR$(1) and CHR$(0) for their actual ASCII codes, if you like.

You can use ESC (space) to increase or decrease the overall proportional spacing units of proportional printing.

Example:

```
10      LPRINT CHR$(27); "p1";
20      GOSUB 100
30      LPRINT CHR$(27); "p0";
40      GOSUB 100
50      END
100     LPRINT "A STEP FORWARD IN READABILITY AND AESTHETICS"
110     LPRINT "COMES WITH ";
120     LPRINT CHR$(27); "4";
130     LPRINT "PROPORTIONAL PRINTING,";
140     LPRINT CHR$(27); "5";
150     LPRINT "WHERE THE"
160     LPRINT "WIDTH EACH CHARACTERS OCCUPIES IS"
170     LPRINT "PROPORTIONAL TO ITS SHAPE"
180     LPRINT
190     RETURN
```

```
A STEP FORWARD IN READABILITY AND AESTHETICS
COMES WITH PROPORTIONAL PRINTING,WHERE THE
WIDTH EACH CHARACTERS OCCUPIES IS
PROPORTIONAL TO ITS SHAPE

A STEP FORWARD IN READABILITY AND AESTHETICS
COMES WITH PROPORTIONAL PRINTING,WHERE THE
WIDTH EACH CHARACTERS OCCUPIES IS
PROPORTIONAL TO ITS SHAPE
```

A STEP FORWARD IN READABILITY AND AESTHETICS COMES WITH *PROPORTIONAL PRINTING*, WHERE THE WIDTH EACH CHARACTERS OCCUPIES IS PROPORTIONAL TO ITS SHAPE

A STEP FORWARD IN READABILITY AND AESTHETICS COMES WITH *PROPORTIONAL PRINTING*, WHERE THE WIDTH EACH CHARACTERS OCCUPIES IS PROPORTIONAL TO ITS SHAPE

PROPORTIONAL SPACING

Format:

BASIC	CHR$(27);" ";CHR$(n)	(n = 0 to 127)
Hex	1B 20 nh	(nh = 00h to 7Fh)

Proportional spacing lets you vary the space *between* characters (whereas character width commands let you change the width of the actual character). This feature can be used in creating justified text or if you just want the print to appear "looser", such as in headlines. The spacing is changed in 1/120 inch units.

The command uses ESC, followed by the space character (ASCII 32) and the number of additional print columns (or dots) that you would like to place between each (and every) character). For this number, you must use the CHR$ function (or its equivalent) with a value from 0 to 127. To cancel proportional spacing, use the comand ESC " " CHR$(0).

Proportional spacing can be combined with all print features, including proportional printing.

Example:

```
10      FOR N = 0 TO 10
20      LPRINT CHR$(27); " "; CHR$(N);
30      LPRINT "BROADEN YOUR HORIZONS"
40      NEXT N
50      LPRINT CHR$(27); " "; CHR$(0)
60      END
```

```
BROADEN YOUR HORIZONS
BROADEN YOUR HORIZONS
BROADEN YOUR HORIZONS
BROADEN YOUR HORIZONS
BROADEN YOUR HORIZONS
BROADEN YOUR HORIZONS
BROADEN YOUR HORIZONS
BROADEN YOUR HORIZONS
BROADEN YOUR HORIZONS
BROADEN YOUR HORIZONS
BROADEN YOUR HORIZONS
```

Justified printing

Format:

BASIC	CHR$(27) "a" CHR$(n)	(n = 0 to 3)
Hex	1B 61 nh	(nh = 00h to 03h)

Justified printing prints lines in the correspondence quality mode that are aligned in any of four different ways. To use this command, send the 120D+ ESC a followed by the ASCII code for the number of the type of justified printing you want, from 0 to 3 (see Table 4-2).

TABLE 4-2. STYLES OF JUSTIFIED PRINTING

n	Justification style
0	Flush against the left margin (default)
1	Centred between the left and right margins
2	Flush against the right margin
3	Flush against both margins (fully justified)

With fully justified printing, the 120D+ adjusts each space between words from 0.5 to 2 characters width. If it fails, the word on the margin is recorrected almost to the original position.

Example:

```
10      LPRINT CHR$(27); "x1";
20      LPRINT CHR$(27); "Q"; CHR$(40);
30      LPRINT CHR$(27); "a"; CHR$(0)
40      LPRINT "FLUSH TO LEFT MARGIN"
50      LPRINT CHR$(27); "a"; CHR$(1)
60      LPRINT "CENTRED BETWEEN MARGINS"
70      LPRINT CHR$(27); "a"; CHR$(2)
80      LPRINT "FLUSH TO RIGHT MARGIN"
90      LPRINT CHR$(27); "a"; CHR$(3)
100     LPRINT "THIS LINE IS JUSTIFIED FLUSH ON BOTH SIDES"
```

```
FLUSH TO LEFT MARGIN

          CENTRED BETWEEN MARGINS

                        FLUSH TO RIGHT MARGIN

THIS LINE IS JUSTIFIED FLUSH ON BOTH SIDES
```

PRINT DENSITY

When printing text, it is sometimes desirable to have some words stand out darker than the rest. Titles are often printed in boldface, for example. The 120D+ has two features that let you vary the darkness, or density, or the print: emphasised and doublestrike print. For very dark printing, you can use both at once. Emphasised and doublestrike print are described below.

Emphasised print

Format:	ON	OFF
BASIC	CHR$(27) "E"	CHR$(27) "F"
Hex	1B 45	1b 46

In emphasised print, the characters are double-printed in one pass. Each character is printed a second time offset just slightly to the right so that the dots overlap and produce a shadow effect. You can combine emphasised with doublestrike for even darker print.

Emphasised print can be combined with all print style commands except reverse print and correspondence quality. Emphasised print can also be selected with ESC!

Example:

```
10      LPRINT CHR$(27); "E"
20      LPRINT "THIS LINE IS PRINTED IN EMPHASISED "
30      LPRINT CHR$(27); "G"
40      LPRINT "THIS LINE IS PRINTED IN EMPHASIZED, DOUBLESTRIKE "
50      LPRINT CHR$(27); "F"; CHR$(27); "H"
60      END
```

Doublestrike print

Format:	ON	OFF
BASIC	CHR$(27) "G"	CHR$(27) "H"
Hex	1B 47	1B 48

In doublestrike printing, the entire line is printed twice. On the second pass, the line is moved up very slightly so that the dots print just below those from the first pass. You can combine doublestrike with emphasised for even darker print.

Doublestrike print can be combined with all print style commands except reverse print. Doublestrike-emphasised print cannot be used with correspondence quality. Doublestrike print can also be selected with ESC!.

Example:

```
10      LPRINT CHR$(27); "G"
20      LPRINT "THIS LINE IS PRINTED IN DOUBLESTRIKE "
30      LPRINT CHR$(27); "E"
40      LPRINT "THIS LINE IS PRINTED IN EMPHASIZED, DOUBLESTRIKE "
50      LPRINT CHR$(27); "F"; CHR$(27); "H"
60      END
```

```
THIS LINE IS PRINTED IN EMPHASISED
THIS LINE IS PRINTED IN EMPHASIZED, DOUBLESTRIKE
```

SPECIAL EFFECTS

The 120D+ printer has additional print features that allow you to achieve some very special effects. This section covers italics, underlining, reverse print, as well as superscripts and subscripts. Except for reverse print, all of these features can be combined with the character width and print density features already discussed in this chapter. Together they produce over 200 varieties of print styles!

Italics

Format:	**ON**	**OFF**
BASIC	CHR$(27) "4"	CHR$(27) "5"
Hex	1B 34	1B 35

In the Epson configuration, the 120D+ has a complete italic character set separate from its standard roman characters which can be combined with any print features. The command to turn on italics is ESC 4; ESC 5 turns off italics.

In the IBM configuration, ESC 4 sets the top-of-form; ESC 5 controls the automatic line feed feature. See Chapter 5 for details. However, you can select italics in the IBM mode by using the master print mode command, ESC!, described later in this chapter.

Example:

```
10      WIDTH "LPT1:", 30'SET COLUMN WIDTH OF 30
20      FOR N = 32 TO 126: A$ = A$ + CHR$(N): NEXT
30      LPRINT CHR$(27); "4"; "ITALIC CHARACTER SET:"
40      LPRINT A$: LPRINT
50      LPRINT CHR$(27); "5"; "STANDARD CHARACTER SET:"
60      LPRINT A$
70      WIDTH "LPT1:", 80'RESETS COLUMN WIDTH
ITALIC CHARACTER SET:
 !"£$%&'()*+,-./0123456789:;<=
>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[
\]^_`abcdefghijklmnopqrstuvwxy
z{|}~
STANDARD CHARACTER SET:
 !"£$%&'()*+,-./0123456789:;<=
>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[
\]^_`abcdefghijklmnopqrstuvwxy
z{|}~
```

Underlining

Format:	**ON**	**OFF**
BASIC	CHR$(27) "—1"	CHR$(27) "—0"
Hex	1B 2D 01	1B 2D 00

The 120D+ can underline any of its print styles, roman or italic. The underline command uses a — (hyphen) as well as 1 and 0 as its on and off switches. Sending ESC "—1" turns underlining on; ESC "—0" turns underlining off. Since the 1 and the 0 work as on and off switches rather than actual characters, you can substitute CHR$(1) and CHR$(0) for their actual ASCII codes, if you like.

Underlining can be used to draw rules, to set something apart, to create special forms, or for "fill-in-the-blanks". You can do this by underlining blank spaces. The 120D+ does not underline leading and trailing spaces or horizontal tabs. However, by starting and ending a print string with the underline character on your keyboard, you can underline blank space. (Of course, you can achieve the same results by printing a string of 25 underline characters.)

Example:

```
10      LPRINT CHR$(27); "-1"
20      LPRINT "UNDERLINING"; CHR$(27); "-0";
30      LPRINT " ADDS EMPHASIS"
40      LPRINT CHR$(27); "-1"
50      LPRINT CHR$(9); CHR$(9); "   CENTRED   "; CHR$(9); "TAB": LPRINT
60      LPRINT "                 "
70      LPRINT CHR$(27); "-0";
80      LPRINT "   SIGN HERE"
90      END
```

```
UNDERLINING ADDS EMPHASIS

                    CENTRED      TAB

_________________
   SIGN HERE
```

NOTE: In the IBM configuration, the 120D+ cannot underline the characters ASCII 176 through to 223 and 244.

Overscoring

Format:	**ON**	**OFF**
BASIC	CHR$(27) "__1"	CHR$(27) "__0"
Hex	1B 5F 01	1B 5F 00

In the IBM Graphics Printer configuration, the 120D+ can overscore any of its print styles. The overscore command uses a __ (underline character) as well as 1 and 0 as its on and off switches. Sending ESC "__1" turns overscoring on; ESC "__0" turns overscoring off. Since the 1 and the 0 work as on and off switches rather than actual characters, you can substitute CHR$(1) and CHR$(0) for their actual ASCII codes, if you like.

Overscoring can be used in writing technical specifications where some terms are printed with a line above them. It can also be used to draw rules, to set something apart, to create special forms, or for "fill-in-the-blanks".

Example:

```
10      LPRINT "TECHNICAL TERMS LIKE:": LPRINT
20      LPRINT CHR$(27); "_1"; "STROBE"; CHR$(9); "ACKNLG": LPRINT
30      LPRINT CHR$(27); "_0"; "CAN BE OVERSCORED": LPRINT
40      LPRINT CHR$(27); "_1";
50      LPRINT CHR$(9); " SIGN HERE "
60      LPRINT CHR$(27); "_0";
70      END
```

```
TECHNICAL TERMS LIKE:

STROBE  ACKNLG

CAN BE OVERSCORED

          SIGN HERE
```

NOTE: In the program above, line 5 switches the 120D+ to the IBM configuration to use the overscore feature. Line 80 switches back to the Epson configuration. The ESC ~5 command is described later in this chapter.

In the IBM configuration, the 120D+ cannot overscore the characters ASCII 176 through 223 and 244.

Reverse print

Reverse print lets you print white letters on a black background (for creating extra emphasis, drawing borders, special effects and so on). Reverse print is compatible only with pica (10 pitch) and elite (12 pitch). Underlining cannot be used with reverse print.

Reverse print is turned on with ESC ~2 (the character before the 2 is called a "tilde" or ASCII 126.) The command uses 1 and 0 as its on and off switches. Sending ESC ~21 turns on reverse print; ESC ~ turns off reverse print. Since the 1 and the 0 work as on and off switches rather than actual characters, you can substitute CHR$(1) and CHR$(0) for their actual ASCII codes, if you like.

Examples:

```
10      LPRINT CHR$(27); "~21"; "<<<<<<<<0>>>>>>>>"
20      LPRINT : LPRINT " +REVERSE PRINT+ "
30      LPRINT : LPRINT "~~~~~~~~~~~~~~~~~~"
40      LPRINT CHR$(27); "~20"
50      END
```

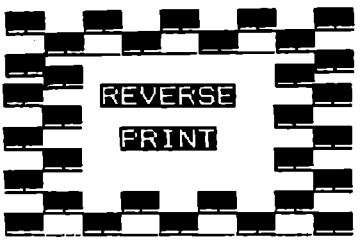
```
<<<<<<<<0>>>>>>>>

 +REVERSE PRINT+

~~~~~~~~~~~~~~~~~~
```

NOTE; In the following program, line 5 contains a command from Chapter 5 which changes the line spacing so that the corners of the blocks touch.

```
10      LPRINT CHR$(27); "A"; CHR$(8)
20      REV$ = CHR$(27) + "~21": NML$ = CHR$(27) + "~20"
30      BLK$ = REV$ + "__" + NML$
40      A$ = BLK$ + "__": B$ = "__" + BLK$: SP$ = "      " '10 SPACES
50      FOR K = 1 TO 4: LPRINT A$; : NEXT: LPRINT BLK$
60      FOR K = 1 TO 4: LPRINT B$; : NEXT: LPRINT
70      LPRINT A$; SP$; B$
80      LPRINT B$; SP$; A$
90      LPRINT A$; " "; REV$; "REVERSE"; NML$; "  "; B$
100     LPRINT B$; SP$; A$
110     LPRINT A$; "  "; REV$; "PRINT"; NML$; "   "; B$
120     LPRINT B$; SP$; A$
130     LPRINT A$; SP$; B$
140     FOR K = 1 TO 4: LPRINT B$; : NEXT: LPRINT
150     FOR K = 1 TO 4: LPRINT A$; : NEXT: LPRINT BLK$
160     END
```



Superscripts

Format:	ON	OFF
BASIC	CHR$(27) "S0"	CHR$(27) "T"
Hex	1B 53 00	1B 54

Superscripts are printed at half their normal height in the top half of the line. The width of the "script" characters matches whatever pitch is in effect. Superscripts can be used with all of the 120D+'s features except correspondence quality and reverse print. Superscripts can be used for footnotes, mathematical formulae, small printing and for legal contracts, and so on.

Sending the ESC S0 command turns on superscripts; ESC T turns off superscripts (and subscripts) and returns to normal (full-height) characters. Since the 0 works as an on switch rather than an actual character, you can substitute CHR$(0) for the actual ASCII code, if you like.

Example:

```
5       WIDTH LPRINT 255
10      LPRINT CHR$(15); CHR$(27); "S0";
20      LPRINT CHR$(27); "A"; CHR$(6); CHR$(27); "U1"
30      LPRINT "WHEREAS THE PARTY OF THE FIRST PART,";
40      LPRINT "HEREINAFTER KNOWS=N AS USER, AGREES TO SEND"
50      LPRINT "CERTAIN CODES TO THE PARTY OF THE SECOND PART,";
60      LPRINT "HERINAFTER KNOWN AS PRINTER & SHALL"
70      LPRINT "PRINT LINES OF TEXT IN FINE PRINT UNTIL USER";
80      LPRINT "SENDS CODES TO CANCEL SAID FINE PRINT."
90      LPRINT CHR$(27); "@";
100     END
```

```
WHEREAS THE PARTY OF THE FIRST PART,HEREINAFTER KNOWS=N AS USER, AGREES TO SEND
CERTAIN CODES TO THE PARTY OF THE SECOND PART,HERINAFTER KNOWN AS PRINTER & SHALL
PRINT LINES OF TEXT IN FINE PRINT UNTIL USERSENDS CODES TO CANCEL SAID FINE PRINT.
```

NOTE: The program above uses commands from later chapters in this manual. Line 5 sets the width of the line to accept up to 255 characters (otherwise, with some computers such as the IBM-PC, a line feed and carriage return will automatically be inserted after 80 characters). Line 20 changes the line spacing to 12 lines per inch (the 6 is for 6/72") and turns on unidirectional print. Line 100 cancels all of the commands and returns the 120D+ to normal pica print.

Subscripts

Format	**ON**	**OFF**
BASIC	CHR$(27) "S1"	CHR$(27) "T"
Hex	1B 53 01	1B 54

Subscripts are printed at half their normal height in the bottom half of the line. The width of the "script" characters matches whatever pitch is in effect. Subscripts can be used with all of the 120D+'s features except correspondence quality and reverse print. Subscripts can be used for footnotes, mathematical formulae, small printing for legal contracts, and so on.

Sending the ESC S1 command turns on subscripts; ESC T turns off subscripts (and superscripts) and returns to normal (full-height) characters. Since the 1 works as an on switch rather than an actual character, you can substitute CHR$(1) for the actual ASCII code, if you like.

Example:

```
SUPERSCRIPT PRINTS IN THE TOP HALF OF THE LINE

SUBSCRIPT PRINTS IN THE BOTTOM HALF OF THE LINE
```

```
10      LPRINT CHR$(27); "S0"
20      LPRINT "SUPERSCRIPT ";
30      LPRINT CHR$(27); "T";
40      LPRINT "PRINTS IN THE TOP HALF OF THE LINE"
50      LPRINT CHR$(27); "S1"
60      LPRINT "SUBSCRIPT ";
70      LPRINT CHR$(27); "T";
80      LPRINT "PRINTS IN THE BOTTOM HALF OF THE LINE"
90      END
```

Character height and width

Up to this point, you have learned how to enlarge (expand) the character width. The 120D+ has another feature that lets you enlarge the character height: vertically enlarged printing. This feature is especially useful for printing signs and headlines.

Enlarged print

Format:

BASIC	*CHR$(27) "~1" CHR$(n)*	(*n* = 0 to 6)
Hex	1B 7E *n*h	(*n*h = 00 h to 0 6h)

Enlarged print makes characters twice (double) or four times (quad) larger than normal height characters. The print head makes multiple passes over the paper. Enlarged print can be used with all character widths and print styles except superscript, subscript and reverse print. Double and quadruple size characters can be accessed manually from the control panel as described on page 5.

In BASIC ESC ~ In turns on enlarged print; ESC ~10 turns it off and returns printing to normal height (the character before the 1 is called a "tilde", or ASCII 126).

---

n Enlargement parameter
0 Normal default width, height
1 Double height
2 Quadruple height
3 Double width
4 Quadruple width
5 Double height and width
6 Quadruple height and width

The 120D+ adjusts the line spacing following a line of vertically enlarged characters by advancing the paper two lines instead of one.

Examples:

```
10      LPRINT CHR$(27); "~11"
20      LPRINT "     CAUTION !!" '5 SPACES IN QUOTES
30      LPRINT CHR$(27); "~10";
40      LPRINT "COMPUTERS USED HERE"
50      END
```

CAUTION !!

COMPUTERS USED HERE

```
10      LPRINT CHR$(27); "x1";
20      X = 0
30      GOSUB 1000
40      LPRINT "IN NORMAL MODE"
50      X = 5
60      GOSUB 1000
70      LPRINT "IN DOUBLE WIDTH / DOUBLE HEIGHT MODE"
80      X = 6
90      GOSUB 1000
100     LPRINT "IN QUADRUPLE HEIGHT / QUADRUPLE WIDTH
110     END
1000    LPRINT
1100    LPRINT CHR$(27); "~1"; CHR$(X);
1200    LPRINT "CITIZEN 120D+"
1300    LPRINT CHR$(27); "~10";
1400    RETURN
```

CITIZEN 120D+
IN NORMAL MODE
CITIZEN 120D+
IN DOUBLE WIDTH / DOUBLE HEIGHT MODE
CITIZEN 120D+
IN QUADRUPLE HEIGHT / QUADRUPLE WIDTH MODE

```
10      ESC$ = CHR$(27)
20      LPRINT ESC$; "x1"; ESC$; "p1"; ESC$; "W1"; ESC$; "~11"
30      LPRINT "Printing text"
40      LPRINT "S"; ESC$; "~10"; ESC$; "W0"; "tarting with this chapter we'll"
50      LPRINT "look at each of the printer features in detail_"
60      LPRINT "what the feature does, how it works, and how to use it."
70      END
```

Printing text
Starting with this chapter we'll
look at each of the printer features in detail_
what the feature does, how it works, and how to use it.

THE MASTER COMMANDS

As you have seen, the 120D+ has quite a number of text printing features, with different commands to turn each feature on and off. So many, in fact, that keeping track of which features are on and off when writing a program can be quite a chore. Consider, for example, how you would tell the 120D+ to change from expanded emphasised pica italic to underlined elite doublestroke. First, you would turn off expanded with ESC W0, turn off emphasised with ESC F, and turn off italic with ESC 5. Then you would turn on underlining with ESC ... well, you see what we mean.

Fortunately, there is an easier way. The 120D+ has three master commands that each control several features at once: the master reset command, the master pitch command, and the master print mode command.

Master reset

BASIC	CHR$(27) "@"
Hex	1B 40

Master reset, sometimes known as *initialisation*, cancels all features and resets all values to their default settings except those set by the front panel. It is equivalent to switching off the power to the 120D+ and turning it on again. Table 3-1 lists the printer initialisation settings and Appendix D describes the power on default settings as set by the internal switches.

Example:

```
10      ESC$ = CHR$(27)
20      LPRINT ESC$; "M"; ESC$; "W1"; ESC$; "E"; ESC$; "4"
30      LPRINT "ELITE EXPANDED EMPHASIZED ITALIC"
40      LPRINT CHR$(27); "@"
50      LPRINT "BACK TO PLAIN PICA IN ONE COMMAND"
60      END
```

ELITE EXPANDED EMPHASIZED ITALIC

BACK TO PLAIN PICA IN ONE COMMAND

NOTE: In the Epson 2 configurations, internal switch 7 must be set to the OFF position for ESC @ to reset to pica pitch (see Appendix D).

Master pitch

BASIC	CHR$(27) "~3" CHR$(n) (0,1,2,5,6 or 7)
Hex	1B 7E 33 nh (nh=00h, 01h, 05h,06h, or 07h)

The master pitch command lets you change between compressed and normal print in pica or elite pitch, using just one command. The master pitch command is ESC ~3 (the character before the 3 is called a "tilde", or ASCII 126). Table 4-3 shows the values of n and the pitch selected:

TABLE 4-3. VALUES FOR MASTER PITCH NUMBERS

n	Pitch
0	Pica
1	Elite (High speed)
2	Pica compressed
5	13.3 CPI
6	15 CPI
7	Elite compressed

To select the particular pitch combination you want, send its ASCII code number, CHR$(0), CHR$(1), CHR$(2), or CHR$(7), after the master pitch command.

Please note High-speed Elite mode is selected using this command.

Unlike some other commands, you cannot attach the pitch number to the master command with a statement like LPRINT CHR$(27) "~32". You must use the CHR$ function to send the pitch number.

Example:

```
10      LPRINT CHR$(27); "~3"; CHR$(7); CHR$(27); "~80"; "ELITE CONDENSED"
20      LPRINT CHR$(27); "~3"; CHR$(1); CHR$(27); "~80"; "ELITE PITCH"
40      LPRINT CHR$(27); "~3"; CHR$(2); "PICA CONDENSED"
60      LPRINT CHR$(27); "~3"; CHR$(0); "STANDARD PICA"
70      END
```

```
ELITE CONDENSED
ELITE PITCH
PICA CONDENSED
STANDARD PICA
```

Master print mode

BASIC	CHR$(27) "!" CHR$(n)	(n = 0 to 255)
Hex	1B 21 nh	(nh = 00h to FFh)

The master print mode command lets you select most combinations of print pitch, character width, print quality and special effect — using just one command. Each combination of features on the 120D+ is assigned a unique number called the "print mode number." You select the print mode you want by sending the ASCII code corresponding to its print mode number (n).

For example, elite emphasised expanded compressed underline italics, thankfully, is simply code 237. To select this mouthful, you can send the command ESC ! CHR$(237).

NOTE: Apple users and others whose computers send only seven bits of data cannot produce underlining with ESC !. These computers can obtain underlining only with the ESC — command. See "The Eighth Bit" section in Chapter 9.

Each of the seven features selectable with the master print mode command has a value associated with it as shown in Table 4-4.

TABLE 4-4. VALUE FOR PRINT MODE NUMBERS.

Bit	Feature	Value
0	Pica	0
0	Elite (High Speed)	1
1	Proportional	2
2	Compressed	4
3	Emphasised	8
4	Doublestrike	16
5	Expanded	32
6	Italics	64
7	Underlining	128

The print mode number for any combination of features is the sum of the feature's values. For example:

Elite	= 1
Emphasised	= 8
Expanded	= 32
Compressed	= 4
Underlined	= 128
Italic	= 64
Print mode number	= 237

Each feature is controlled by one bit in a byte of memory (bit 1 is unused). The feature is activated when its bit is on; inactive when its bit is off. A feature's value is the decimal equivalent of the 8-digit binary number with a 1 in the position corresponding to the feature's bit number.

Example:

```
10      LPRINT CHR$(27); "!"; CHR$(244)
20      LPRINT "COMPRESSED EXPANDED DOUBLESTRIKE UNDERLINED ITALICS"
30      LPRINT CHR$(27); "!"; CHR$(0)
40      LPRINT "BACK TO PLAIN PICA PRINTING"
```

COMPRESSED EXPANDED DOUBLESTRIKE UNDERLINED ITALICS

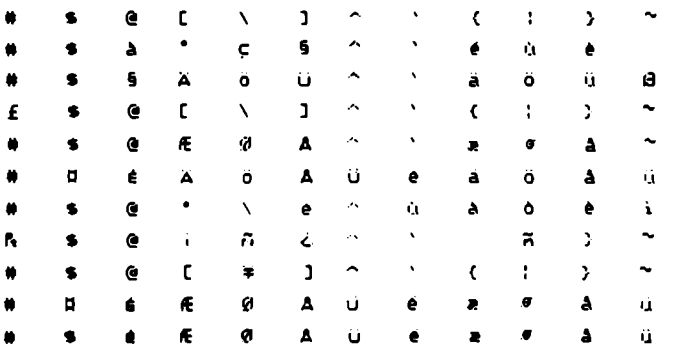
BACK TO PLAIN PICA PRINTING

The following program selects any of 128 different print styles. It can be used as a handy reference chart showing all of the possible print mode numbers along with a sample of each of the 120D+'s print styles.

```
10      LPRINT CHR$(27); "!"; CHR$(56)
20      LPRINT "PRINTER PRINT MODE CHART":
30      LPRINT CHR$(27); "!"; CHR$(0)
40      LPRINT " ULN ITA EXP DBL EMP CMP PRO ELT"
50      LPRINT " 128 64  32  16   8   4   2   1":
60      FOR N7 = 0 TO 128 STEP 128
70      FOR N6 = 0 TO 64 STEP 64
80      FOR N5 = 0 TO 32 STEP 32
90      FOR N4 = 0 TO 16 STEP 16
100     FOR N3 = 0 TO 8 STEP 8
110     FOR N2 = 0 TO 4 STEP 4
115     FOR N1 = 0 TO 2 STEP 2
120     FOR N0 = 0 TO 1 STEP 1
130     LPRINT " ";
140     IF N7 THEN LPRINT "! * ";  ELSE LPRINT "!    ";
150     IF N6 THEN LPRINT "! * ";  ELSE LPRINT "!    ";
160     IF N5 THEN LPRINT "! * ";  ELSE LPRINT "!    ";
170     IF N4 THEN LPRINT "! * ";  ELSE LPRINT "!    ";
180     IF N3 THEN LPRINT "! * ";  ELSE LPRINT "!    ";
190     IF N2 THEN LPRINT "! * ";  ELSE LPRINT "!    ";
195     IF N1 THEN LPRINT "! * ";  ELSE LPRINT "!    ";
200     IF N0 THEN LPRINT "! * ";  ELSE LPRINT "!    ";
210     N = N0 + N1 + N2 + N3 + N4 + N5 + N6 + N7
220     LPRINT "!";
230     LPRINT CHR$(27); "!"; CHR$(N); "PRINT MODE"; N;
240     LPRINT CHR$(27); "!"; CHR$(0)
250     NEXT N0, N1, N2, N3, N4, N5, N6, N7
260     END
```

SPECIAL CHARACTERS AND SYMBOLS

In addition to letters, numbers, and punctuation in both roman and italic, the 120D+ also has many accented characters, math and graphic symbols, and even Greek letters in its repertoire as in the following example.



Character Font Selection

BASIC	CHR$(27) "k" CHR$(n)	(*n*=0 or 1)
Hex	1B 4B nh	(*nh*= 00 or 01)

This command selects between the two resident fonts in your 120D+ where:

font 1 = Courier	n = 0
font 2 = Citizen Display	n = 1

The default font for your 120D+ can be set using the internal switches (see Appendix D), however you can also change the character font using the software commands. Try the following programs:

```
10   LPRINT CHR$(27); "k"; CHR$(0);
20   LPRINT "THE CITIZEN 120D+ IS PRINTING THIS IN THE COURIER FONT STYLE";
30   LPRINT CHR$(27); "k"; CHR$(1);
40   LPRINT "WE CAN CHANGE THE TYPE STYLE WITH EASE TO DISPLAY";
50   LPRINT CHR$(27); "k"; CHR$(0);
60   LPRINT " AND BACK AGAIN"
```

```
THE CITIZEN 120D+ IS PRINTING THIS IN THE COURIER FONT STYLE
WE CAN CHANGE THE TYPE STYLE WITH EASE TO DISPLAY AND BACK AGAIN
```

Accented (International) character sets

BASIC	CHR$(27) "R" CHR$(n)	(n = 0 to 10)
Hex	1B 52 nh	(nh = 01 to 0Ah)

The 120D+ can print accented characters from nine languages by redefining up to 12 of the standard ASCII codes to accommodate the accented characters and special symbols used in each language. There are eleven international character sets available.

NOTE: In the IBM Graphics Printer configuration, ESC R clears all horizontal and vertical tabs (htabs and vtabs). See Chapter 6 for details.

To select a particular set of characters, send ESC R followed by the ASCII code number for the set you want. The values of n are shown in Table 4-5.

TABLE 4-5. VALUES OF n FOR INTERNATIONAL CHARACTER SETS.

n	Country	n	Country
0	U.S.A.	6	Italy
1	France	7	Spain
2	Germany	8	Japan
3	England	9	Norway
4	Denmark I	10	Denmark II
5	Sweden		

To print a character from the international character set you selected, send its ASCII code number (or its equivalent character in standard ASCII). The ASCII codes that change and the international characters are shown in Table 4-6.

TABLE 4-6. INTERNATIONAL CHARACTERS

ASCII CODES

Country	35	36	64	91	92	93	94	96	123	124	125	126
U.S.A.	#	$	@	[	\	]	^	`	{	|	}	~
France	#	$	à	°	ç	§	^	`	é	ù	è	
Germany	#	$	§	Ä	ö	Ü	^	`	ä	ö	ü	ß
England	£	$	@	[	\	]	^	`	{	|	}	~
Denmark I	#	$	@	Æ	ø	Å			æ	ø	å	~
Sweden	#	¤	É	Ä	Ö	Å	Ü	é	ä	ö	å	ü
Italy	#	$	@	°	\	é	^	ù	à	ò	è	ì
Spain	₧	$	@	¡	Ñ	¿		`		ñ	}	~
Japan	#	$	@	[	¥	]	^	`	{	|	}	~
Norway	#	¤	É	Æ	Ø	Å	Ü	é	æ	ø	å	ü
Denmark II	#	$	É	Æ	Ø	Å	Ü	é	æ	ø	å	ü

To restore the international characters to their standard ASCII form (U.S.A.), use the command ESC R CHR$(0). International characters can be used with any of the 120D+'s other features, including correspondence quality, and italics.

In the Epson configurations, international characters can be selected as the power-on default by changing the internal switches (see Appendix D).

Example:

```
10      LPRINT CHR$(27); "R"; CHR$(7)
20      LPRINT CHR$(91); "HASTA MA"; CHR$(92); "ANA!"
30      END

¡HASTA MAÑANA!
```

NOTE: In the Spanish character set (n = 7), the left bracket, ASCII code 91, is redefined as ¡ and the backslash, ASCII code 92, is redefined as Ñ. Alternatively, you could change line 20 to LPRINT CHR$(91) "HASTA MA" CHR$(92) "ANA!" which would give you the same results.

Switching configurations

	Epson configuration	**IBM configuration**
BASIC	CHR$(27) "~50"	CHR$(27) "~51"
Hex	1B 7E 35 00	1B 7E 35 01

This command switches the 120D+ printer between the Epson FX/LX configuration and the IBM Graphics Printer configuration. The command uses 1 and 0 as its on and off switches. Sending the command ESC ~51 switches to the IBM Graphics Printer configuration; ESC ~50 switches to the Epson configuration. Since the 1 and the 0 work as on and off switches rather than actual characters, you can substitute CHR$(1) and CHR$(0) for their actual ASCII codes, if you like.

Changing configurations changes the functions of the ESC A and ESC 2 commands. In the Epson configuration, ESC A sets the line spacing in n/72 inch increments, and ESC 2 sets the line spacing to 1/6 inch. However, in the IBM 1 configuration, ESC 2 must be used to activate the line spacing previously defined in ESC A. If ESC A is not used, ESC 2 sets the line spacing to either 1/6 (internal switch 5 OFF) or 1/8 inch (internal switch 5 ON).

Changing configurations also changes the character set of the 120D+. High-bit ASCII codes 160 to 255 are italic characters in the Epson configuration. The IBM Graphics Printer configuration provides line graphics, math symbols, and Greek letters as used on IBM and compatible computers (these characters can be printed using the example program below). The ESC 6 and ESC 7 commands only work in the IBM Graphics Printer configuration.

The IBM Graphics Printer characters are compatible with all of the 120D+'s print modes with just two exceptions:
1 IBM characters ASCII 244 to 255 are not available in italic in Font 1.
2 No IBM characters are available in italic in Font 2.

The two IBM Graphics Printer configurations can be selected as the power-on default by setting internal switches 2 and 3. There are two Epson configurations which alter the functions you can control. Switches 2 and 3 also select these two configurations. All switch settings are described in Appendix D.

Example:

```
        WIDTH LPRINT 255
5       LPRINT CHR$(27); "x1";
10      LPRINT CHR$(27); "~51"
20      FOR J = 160 TO 183
30      FOR N = J TO J + 72 STEP 24
40      LPRINT N; "   "; CHR$(N); "   ";
50      NEXT: LPRINT : LPRINT : NEXT
60      LPRINT CHR$(27); "~50"
```

160	á	184	╕	208	╨	232	Φ
161	í	185	╣	209	╤	233	Θ
162	ó	186	║	210	╥	234	Ω
163	ú	187	╗	211	╙	235	δ
164	ñ	188	╝	212	╘	236	∞
165	Ñ	189	╜	213	╒	237	ø
166	ª	190	╛	214	╓	238	∈
167	º	191	┐	215	╫	239	∩
168	¿	192	└	216	╪	240	≡
169	⌐	193	┴	217	┘	241	±
170	¬	194	┬	218	┌	242	≥
171	½	195	├	219	█	243	≤
172	¼	196	─	220	▄	244	⌠
173	¡	197	┼	221	▌	245	⌡
174	«	198	╞	222	▐	246	÷
175	»	199	╟	223	▀	247	≈
176		200	╚	224	α	248	°
177	▒	201	╔	225	ß	249	∙
178	▓	202	╩	226	Γ	250	·
179	│	203	╦	227	π	251	√
180	┤	204	╠	228	Σ	252	ⁿ
181	╡	205	═	229	σ	253	²
182	╢	206	╬	230	µ	254	■
183	╖	207	╧	231	τ	255	

ASCII codes 128 to 159

The first 32 high-bit ASCII codes, numbered 128 to 159, correspond to the first 32 standard ASCII codes, which are non-printing control codes. ASCII codes 128 to 159, therefore, normally perform the same control code functions as their low-bit counterparts. They are occasionally useful as substitutes when your computer has a problem with a particular low-bit control code — for example, you can use CHR$(137) if your computer cannot properly send CHR$(9) to the printer. Otherwise, these codes are generally unused.

The 120D+ provides a way to put these idle codes to work. The commands below show you how.

Select graphics and accented characters

	ON	OFF
BASIC	CHR$(27) "m" CHR$(4)	CHR$(27) "m" CHR$(0)
Hex	1B 6D 04	1B 6D 00

High-bit ASCII codes 128 to 159 are normally control codes identical to ASCII 0 to 31. This command redefines these high-bit codes to line and block graphics characters in the Epson configuration, or accented characters in the IBM Graphics Printer configuration. Table 4-7 shows the characters that change in each configuration.

TABLE 4-7. GRAPHICS AND ACCENTED CHARACTERS ASCII 128 — 159

IBM character set:

128	Ç	129	ü	130	é	131	â
132	ä	133	à	134	å	135	ç
136	ê	137	ë	138	è	139	ï
140	î	141	ì	142	Ä	143	Å
144	É	145	æ	146	Æ	147	ô
148	ö	149	ò	150	û	151	ù
152	ÿ	153	Ö	154	Ü	155	¢
156	£	157	¥	158	R	159	ƒ

Epson character set:

128	┼	129	┴	130	┬	131	┤
132	├	133	─	134	│	135	┌
136	┐	137	└	138	┘	139	▒
140	■	141	▬	142	▮	143	●
144	○	145	♠	146	♥	147	♦
148	♣	149	♪	150	♫	151	♣
152	♯	153	♀	154	♂	155	↑
156	↓	157	×	158	÷	159	±

* To correspond with the IBM character set, ESC 6 also assigns graphic characters to the following five low-bit ASCII codes: ASCII 3 = , ASCII 4 = , ASCII 5 = , ASCII 6 = , and ASCII 21 = §.

The ESC m command uses CHR$(4) and CHR$(0) as on and off switches. In the Epson configuration, sending ESC m CHR$(4) selects graphic characters; ESC m CHR$(0) cancels graphics in order to use ASCII codes 128 to 159 as control codes again. In the IBM configuration, ESC m CHR$(4) selects accented characters; ESC m CHR$(0) cancels accented characters (the commands ESC 6 and ESC 7 also select accented characters in the IBM configuration).

In the Epson 2 configuration, graphics characters can be selected as the power-on default by setting internal switch 4 ON.

Example:

```
10      LPRINT CHR$(27); "C"; CHR$(6)
20      FOR N = 1 TO 3
30      LPRINT "NAME"
40      LPRINT "ADDRESS"
50      LPRINT "TOWN, COUNTY"
60      LPRINT CHR$(12);
70      NEXT
80      END
```

```
NAME
ADDRESS
TOWN, COUNTY


NAME
ADDRESS
TOWN, COUNTY


NAME
ADDRESS
TOWN, COUNTY
```

Select graphics and accented characters

(IBM compatible)

	ON	OFF
BASIC	CHR$(27) "6"	CHR$(27) "7"
Hex	1B 36	1B 37

In order to maintain full compatibility with the IBM Graphics Printer, ESC 6 and ESC 7 can be used in place of ESC m CHR$(4) and ESC m CHR$(0), respectively. ESC 6 redefines these high-bit codes to accented characters in the IBM Graphics Printer configuration and to line and block graphics in the Epson FX/LX configuration.

The ESC 6 selects graphics and accented characters; ESC 7 cancels graphics and accented characters in order to use ASCII codes 128 to 159 as control codes again. Table 4-7 shows the characters that change in each configuration. In the IBM Graphics Printer configuration, ESC 6 also assigns accented characters to the following low-bit ASCII codes.

Example:

ASCII 3 = ♥ , ASCII 4 = ♦ , ASCII 5 = ♣
ASCII 6 = ♠ et ASCII 21 = §

In either of the IBM configurations, accented characters can be selected as the power-on default by setting internal switch 4 ON (see Appendix D).

Example:

```
10      LPRINT CHR$(27); "^51"
20      LPRINT CHR$(27); "7";
30      LPRINT "CHR$(141) PRINTS AS CARRIAGE RETURN:"
40      FOR N = 1 TO 3: LPRINT CHR$(141): NEXT
50      LPRINT CHR$(27); "6";
60      LPRINT "CHR$(141) PRINTS AS ACCENTED CHARACTER:"
70      FOR N = 1 TO 3: LPRINT CHR$(141): NEXT
80      END


CHR$(141) PRINTS AS CARRIAGE RETURN:


CHR$(141) PRINTS AS ACCENTED CHARACTER:
ì
ì
ì
```

Expand printable area (Epson-compatible)

Format	ON	OFF
BASIC	CHR$(27); "6"	CHR$(27); "7"
Hex	1B 36	1B 37

This command is used to control the characters in ASCII 128 to 159. When ESC 6 is sent to the printer, codes 128 to 159 are printable graphics characters. When ESC 7 is sent to the printer, codes 128 to 159 are control codes. These control codes duplicate the lower half of the character table, in the range 0 to 31.

Printable area expansion (Epson-compatible)

Format	ON	OFF
BASIC	ESC I 1	ESC I 0
Hex	1B 49 31	1B 49 30

ASCII codes 0 to 31 and 128 to 159 are usually not printable. ESC I 1 when sent to the printer allows these ASCII locations to be used for user defined characters, except for ASCII codes 8 to 15, 17 to 20, 24 and 27. These codes cannot be replaced. ESC 10 cancels this feature.

Characters from all characters chart

(IBM configuration)

Print single character from "all characters" chart

BASIC	CHR$(27) "^ " CHR$(n)
Hex	1B 5E nh

This sequence prints one character ASCII value n from the all characters chart given in Appendix B. Nine characters are available that can be used to print codes the printer normally recognizes as control codes.

See ESC \ for further information.

Print continuously from all characters chart

BASIC	CHR$(27) "\" CHR$(n1) CHR$(n2)
Hex	1B 5C n_1 h n_2h

This sequence allows the printing of all characters, including characters with an ASCII value below decimal 32. The printer normally recognizes the ASCII values less than decimal value 32 as control codes. ESC \ allows the printer to print the special symbols assigned to the ASCII control codes. You can also use this sequence to print characters between 128—159 (for character set 1). If the printer receives a code value for an unassigned character, a space character prints. No control code functions operate when this sequence is in effect.

The total number of character is equal to $n_1 + (n_2 \times 256)$.

Character tables — Top set selection

Format:

	CHR$''t''CHR$(*n*)	(*n* = 0 Epson top set)
Hex	1B 74 *n*h	(*n* = 1 IBM top set)

(Epson Configuration)
This command is only available in Epson configuration. The command switches the top set characters that are available but does not change the operating configuration of the printer.

NOTE: *n* = 0, Epson top set — includes graphics
n = 1, IBM top set — includes international characters

CHAPTER 5

PAGE FORMATTING

Page formatting commands tell the 120D+ *where* to print (as opposed to text printing commands that tell it *how* to print). This chapter describes the commands that control where your text appears on the page — the distance between lines, page margins, and page length.

THE END OF THE LINE

How does the printer know when to start a new line? There are two ASCII codes that control the end of a line — ASCII 13, called a *carriage return*, and ASCII 10, called a *line feed*.

Carriage return

BASIC	CHR$(13)
Hex	0D

A carriage return brings the print head to the left margin, but does not advance the paper to the next line. Therefore, many computers automatically add a line feed (ASCII 10) to each carriage return.

You can add a line feed to each carriage return by setting internal switch 2 ON if your computer does not add line feeds for you (see Appendix D).

Example:

```
10      LPRINT "THESE STATEMENTS PRINT"
20      LPRINT "ON TWO LINES"
30      LPRINT "BUT THESE STATEMENTS PRINT ";
40      LPRINT "ON ONE LINE"
50      END
THESE STATEMENTS PRINT
ON TWO LINES
BUT THESE STATEMENTS PRINT ON ONE LINE
```

NOTE: The semicolon in line 20 tells BASIC not to send a carriage return (and line feed) to the printer, allowing you to continue the next statement on the same printed line.

Line feed

BASIC	CHR$(10)
Hex	0A

A line feed returns the print head to the left margin and advances the paper to the next line. Many computers automatically add a line feed to each carriage return. If yours does not, you can add a line feed to each carriage return by setting internal switch 1 ON (see Appendix D).

Example:

```
10      LPRINT "THIS STATEMENT PRINTS"; CHR$(10); "ON TWO LINES"
20      LPRINT "EVEN WITH SEMICOLONS"; CHR$(10); "THESE STATEMENTS PRINT ON TWO
LINES"

THIS STATEMENT PRINTS
ON TWO LINES
EVEN WITH SEMICOLONS
THESE STATEMENTS PRINT ON TWO LINES
```

A note about BASIC

The 120D+ normally starts a new line with each LPRINT statement because BASIC sends these end-of-line codes for you automatically. Depending on the particular BASIC you are using, pressing the RETURN or ENTER key at the end of an LPRINT statement sends both a carriage return and a line feed or just a carriage return to the printer.

The 120D+ adapts to both types of BASIC by means of its internal switch 1. Setting switch 1 ON adds a line feed to each carriage return the 120D+ receives. It should be on if your BASIC does not send a line feed with each carriage return. If your BASIC sends a line feed with each carriage return, switch 1 should be OFF unless you want all of your printing to be double spaced.

You can avoid beginning a new line with each LPRINT statement by ending the statement with a semicolon.

Automatic line feed

	ON	**OFF**
BASIC	CHR$(27) "51"	CHR$(27) "50"
Hex	1B 35 01	1B 35 00

In the IBM Graphics Printer configuration, this command acts like internal switch 1 by controlling whether or not a line feed is automatically added to each carriage return. Actually, it overrides the current setting of switch 1. The command uses 1 and 0 as its on and off switches. Sending ESC "51" turns on the automatic line feed feature; ESC "50" turns off automatic line feed. Since the 1 and the 0 work as on and off switches rather than actual characters, you can substitute CHR$(1) and CHR$(0) for their actual ASCII codes, if you like.

NOTE: In the Epson configuration, ESC 5 cancels italic printing. See Chapter 4 for details.

LINE SPACING

Each time the 120D+ receives a line feed, the paper moves a certain distance. But that distance, called the *line spacing*,need not always be the same. The 120D+ has several commands that allow you to change the line spacing.

When you turn on the 120D+ the line spacing is set to six lines per inch, the standard typewriter spacing. This is the setting you will probably use most often for text, but for some applications you may wish to change to a smaller or larger line spacing.

The line spacing commands are based on multiples of 1/72 of an inch. The reason for this odd measurement is that the pins in the print head are spaced 1/72 inch apart. Using this measure, then, allows you to vary the line spacing by as little as one-third of a dot for very fine graphics.

Fixed line spacing

Fixed line spacing commands let you change the distance the paper is advanced in fixed increments of 1/6 inch, 1/8 inch, or 7/72 inch. The three commands are described below.

1/6 inch line spacing

BASIC	CHR$(27) "2"
Hex	1B 32

This command acts differently, depending on whether you are in the Epson FX/LX configuration or the IBM Graphics Printer configuration. In the Epson configuration (see Appendix D for switch settings), ESC 2 sets line spacing to 1/6 inch, printing six lines per inch.

In the IBM configuration (switch 2 ON), ESC 2 activates the line spacing previously defined in ESC A (explained later in this chapter). If ESC A has not previously been used, ESC 2 sets the line spacing to the power-on default value (1/6 inch with internal switch 5 OFF and 1/8 inch with switch 5 ON).

Example:

```
10      LPRINT "THESE LINES ARE SPACED "
20      LPRINT "AT THE DEFAULT SETTING"
30      LPRINT "OF SIX LINES PER INCH"

THESE LINES ARE SPACED
AT THE DEFAULT SETTING
OF SIX LINES PER INCH
```

1/8 inch line spacing

BASIC	CHR$(27) "0"
Hex	1B 30

This command sets the line spacing to 1/8 inch, printing eight lines per inch. In the IBM configuration (internal switch 2 ON), 1/8 inch line spacing can be selected by setting switch 5 ON.

Example:

```
10      LPRINT CHR$(27); "0"
20      LPRINT "THESE LINES ARE SPACED"
30      LPRINT "AT EIGHT LINES PER INCH"
40      LPRINT "USING THE ESC 0 COMMAND"
50      LPRINT CHR$(27); "2"
60      LPRINT "AND BACK AGAIN"
70      LPRINT "TO SIX LINES PER INCH"
80      LPRINT "WITH THE ESC 2 COMMAND"
90      END
```

```
THESE LINES ARE SPACED
AT EIGHT LINES PER INCH
USING THE ESC 0 COMMAND

AND BACK AGAIN
TO SIX LINES PER INCH
WITH THE ESC 2 COMMAND
```

7/72 inch line spacing

BASIC	CHR$(27) "1"
Hex	1B 31

This command changes the line spacing to 7/72 inch, printing approximately 10.3 lines per inch. It is used mainly with graphics so that the tops and bottoms of the graphic characters connect, but can be used in other applications as well (see the example below).

Example:

```
10      LPRINT CHR$(27); "S0"; CHR$(27); "1"
20      LPRINT "SMALL PRINT LOOKS GOOD"
30      LPRINT "WHEN PRINTED OPN"
40      LPRINT "SMALL LINES"
50      LPRINT CHR$(27); "@"
```

```
SMALL PRINT LOOKS GOOD
WHEN PRINTED OPN
SMALL LINES
```

NOTE: The program above uses ESC S0 to select superscripts.

Variable line spacing

The 120D+ has three commands that allow you to vary the line spacing in increments of 1/72, 1/144, and 1/216 of an inch — that is, one, one-half, and one-third of a dot. The finer increments are used mainly for graphics.

Line spacing of n/72 inch

BASIC	CHR$(27); "A"; CHR$(n)	(n = 0 to 85)
Hex	1B 41 nh	(nh = 00h to 55h)

This command sets the line spacing to n/72 of an inch, adjusting the line spacing to 1-dot increments. To use it, send the 120D+ CHR$(27) "A" followed by the ASCII code for the number of 72nds you want, from 0 to 85. For example, CHR$(27) "A" CHR$(24) will change the line spacing to 24/72 of an inch or 3 lines per inch.

NOTE: The 120D+ interprets the CHR$(27) "A" CHR$(n) command differently depending on its configuration (Epson or IBM Graphics Printer). In the IBM configuration, you need to follow ESC A with ESC 2 to activate the newly defined line spacing.

Examples:

Epson configuration:

```
10      LPRINT CHR$(27); "^51";
20      LPRINT CHR$(27); "A"; CHR$(24); CHR$(27); "2";
30      FOR N = 1 TO 3
40      LPRINT "THESE LINES ARE 24/72 OF AN INCH APART"
50      NEXT
60      LPRINT CHR$(27); "@";
```

```
THESE LINES ARE 24/72 OF AN INCH APART

THESE LINES ARE 24/72 OF AN INCH APART

THESE LINES ARE 24/72 OF AN INCH APART
```

IBM Graphics Printer configuration:

```
10      LPRINT CHR$(27); "A"; CHR$(24)
20      FOR N = 1 TO 3
30      LPRINT "THESE LINES ARE 24/72 OF AN INCH APART"
40      NEXT
50      LPRINT CHR$(27); "@"
60      END
```

```
THESE LINES ARE 24/72 OF AN INCH APART

THESE LINES ARE 24/72 OF AN INCH APART

THESE LINES ARE 24/72 OF AN INCH APART
```

NOTE: In the program above, line 10 selects the IBM Graphics Printer configuration. Line 20 sets a new line spacing with ESC A and is activated by ESC 2 in the same line. After printing the three lines, line 60 resets the line spacing to 1/6-inch (12/72nds) and line 70 returns the 120D+ to the dipswitch selected Epson configuration.

Line spacing of n/144 inch

BASIC	CHR$(27) "~0" CHR$(n)	(n = 0 to 125)
Hex	1B 7E 30 nh	(nh = 00h to 7Dh)

This command sets the line spacing to n/144 of an inch, adjusting the line spacing to 1/2-dot increments. To use it, send the 120D+ CHR$(27) "~0" followed by the ASCII code for the number of 144ths you want, from 0 to 125. For example, CHR$(27) "A" CHR$(36) will change the line spacing to 36/144 of an inch or 4 lines per inch.

Example:

```
10      LPRINT CHR$(27); "~0"; CHR$(12);
20      FOR N = 1 TO 3
30      LPRINT "THESELINES ARE 12/144 OF AN INCH APART"
40      NEXT
50      LPRINT CHR$(27); "@";
60      END
```

```
THESELINES ARE 12/144 OF AN INCH APART
THESELINES ARE 12/144 OF AN INCH APART
THESELINES ARE 12/144 OF AN INCH APART
```

Line spacing of n/216 inch

BASIC	CHR$(27) "3" CHR$(n)	(n = 0 to 255)
Hex	1B 33 nh	(nh = 00h to FFh)

This command sets the line spacing to n/216 of an inch, adjusting the line spacing to 1/3-dot increments. To use it, send the 120D+ CHR$(27) "3" followed by the ASCII code for the number of 216ths you want, from 0 to 255. For example, CHR$(27) "3" CHR$(24) will change the line spacing to 24/216 of an inch or 9 lines per inch.

Example:

```
10      LPRINT CHR$(27); "3"; CHR$(24);
20      FOR N = 1 TO 3
30      LPRINT "THESE LINES ARE 24/216 OF AN INCH APART"
40      NEXT
50      LPRINT CHR$(27); "@";
```

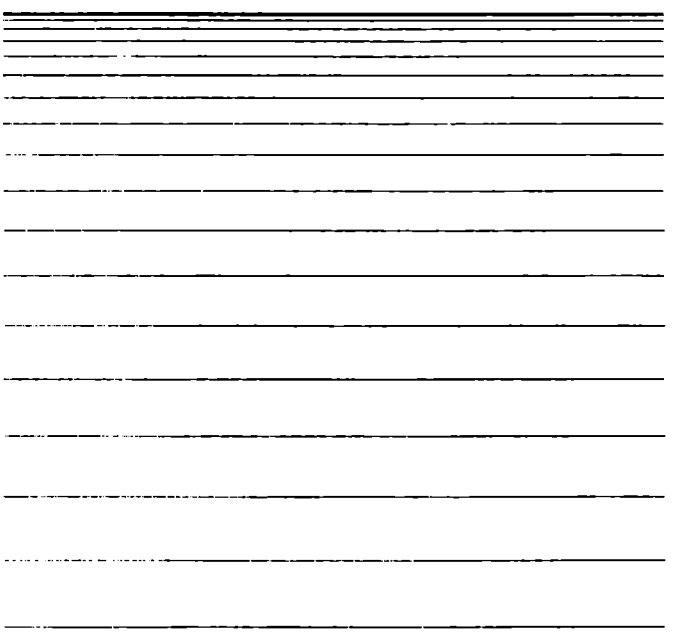
```
THESE LINES ARE 24/216 OF AN INCH APART
THESE LINES ARE 24/216 OF AN INCH APART
THESE LINES ARE 24/216 OF AN INCH APART
```

A variable line spacing example

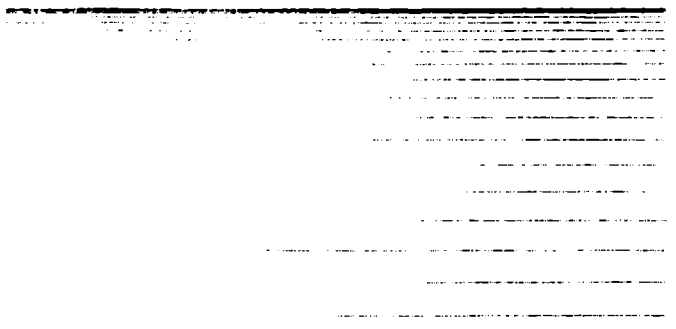
The following program demonstrates the different spacing you can get with the variable line spacing commands:

```
        WIDTH LPRINT 255
10      LPRINT CHR$(27); "~50"
20      K = 0: LPRINT CHR$(27); "-1"
30      SP$(1) = CHR$(27) + "A": SP$(2) = CHR$(27) + "~0": SP$(3) = CHR$(27) + "-
3"
40      LPRINT "ESC A VARIES LINE SPACING BY 1/72 INCH:"
50      GOSUB 90
60      LPRINT "ESC ~0 VARIES LINE SPACING BY 1/144 INCH:"
70      GOSUB 90
72      LPRINT "ESC 3 VARIES LINE SPACING BY 1/216 INCH:"
74      GOSUB 90
80      LPRINT CHR$(27); "-0"; : END
90      K = K + 1
100     FOR N = 0 TO 20
110     IF N = 9 GOTO 150
120     IF N = 13 GOTO 150
130     LPRINT SP$(K) + CHR$(N)
140     GOSUB 190
150     NEXT
160     LPRINT CHR$(27); "2";
170     LPRINT
180     RETURN
190     LPRINT "                                                    " '55 SPACE
S
200     RETURN
210     END
```

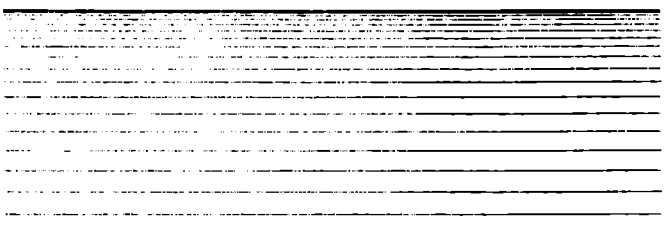
ESC A VARIES LINE SPACING BY 1/72 INCH:



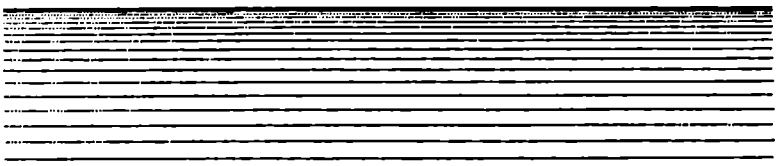
ESC ~0 VARIES LINE SPACING BY 1/144 INCH:



ESC 3 VARIES LINE SPACING BY 1/216 INCH:



ESC 3 varies spacing by 1/216 inch:



In this program, line 20 initialises the counter K and turns on underlining. Line 30 defines the three variable spacing commands as SP$(1), SP$(2), and SP$(3). The commands are actually sent in the subroutine beginning at line 110. The counter K determines which command is needed and line 150 sends it and the value CHR$(n) to the 120D+. The subroutine at line 210 then prints 35 underlines spaces. Line 180 resets the spacing to six lines per inch and skips a line to begin the next set of lines.

VARIABLE LINE FEEDS

If you want to move to another line without returning to the left margin, the 120D+ provides one command to do this. It allows you to move down in 1/216 increments.

Line feed of n/216 inch

BASIC	CHR(27) "J" CHR$(n)	(n = 0 to 255)
Hex	1B 4A nh	(nh = 00h to FFh)

The one-time line feed command immediately advances the paper whatever distance you specify without changing the print head position. To use it, send the 120D+ CHR$(27) "J" followed by the ASCII code for the number of 216ths you want, from 0 to 255.

Example:

```
10      LPRINT "ESC J CHR$(18) ADVANCES"; CHR$(27); "J"; CHR$(18);
20      LPRINT "THE PAPER 1/2 A LINE"
30      END
```

```
ESC J CHR$(18) ADVANCES
THE PAPER 1/2 A LINE
```

PAGE DESIGN

In addition to the commands to control spacing between lines, the 120D+ provides several commands that allow you to adjust the overall placement of the printing on the page.

New page (form feed)

BASIC	CHR$(12)
Hex	0C

A form feed advances the paper to the top of the next page, the same as the FF switch on the 120D+'s control panel does. The 180E measures the length of the page starting with the position of the paper when you first turn on the printer. Therefore, in order for the form feed command to advance the paper the proper distance, you must line up the top of the page at the print head when you turn on the printer or after you send a master reset (ESC @) command.

Some computers cannot send CHR$(12) to the printer properly. If your computer is one of these, you can get the same results by substituting CHR$(140) which is the high-bit ASCII code for CHR$(12).

In the Epson 1 configuration, you can set the power-on default page length to either 11 inches by setting internal switch 7 and 8 OFF, or to 12 inches by setting switch 7 ON. It is also possible to set 8" forms length by setting switch 8 ON. All other configurations automatically set the page length to 11 inches, with switches 7 and 8 down (see Appendix D.) You can also set the page length with ESC C.

Example:

```
NEW
10 LPRINT "This is the top of page 1"
20 LPRINT CHR$(12); "This is the top of page 2"
```

Top of form

BASIC	CHR$(27) "4"
Hex	1B 34

In the IBM Graphics Printer configuration, this command sets the current paper position as the top of the page, or top of form. It is equivalent to setting the top of form when you turn the 120D+ on or when you initialise the printer (except that no other settings are changed). For example, if you are in the middle of a page when you set the top of form, a form feed will advance the paper a full page length which will be to the middle of the next page.

NOTE: In the Epson configuration, ESC 4 selects italic printing. See Chapter 4 for details.

Page length

When you first turn on the 120D+, the page length is set to 11 inches in the Epson 1 configuration if internal switch 8 is set OFF (see Appendix D). Each form feed, therefore, advances the paper 11 inches. Although this is the most common page length, some applications may require a different page length setting. Labels, envelopes, and computer checks are examples.

You can set the page length through software control in two ways: by the number of lines, or by inches. The command to do this is ESC C.

Set page length by lines

BASIC	CHR$(27) "C" CHR$(n)	(n = 1 to 255)
Hex	1B 43 nh	(nh = 01h to FFh)

This command sets the page length to n lines. To use this command, send the 120D+ ESC C followed by the ASCII code for the number of lines you want, from 1 to 255. For example, CHR$(27) "C" CHR$(6) sets the page length to 6 lines, a typical setting for mailing labels.

The actual page length is set internally in inches determined by multiplying the lines per page by the line spacing in effect at the time. Later changes in the spacing, therfore, have no effect on the length of the page. (They will change the number of lines per page, however.)

Example:

```
10        LPRINT CHR$(27); "C"; CHR$(6)
20        FOR N = 1 TO 3
30        LPRINT "NAME"
40        LPRINT "ADDRESS"
50        LPRINT "TOWN, COUNTY"
60        LPRINT CHR$(12);
70        NEXT
80        END
```

```
NAME
ADDRESS
TOWN, COUNTY
```

```
NAME
ADDRESS
TOWN, COUNTY
```

```
NAME
ADDRESS
TOWN, COUNTY
```

Set page length by inches

BASIC	CHR$(27) "C" CHR$(0) CHR$(n)	(n = 1 to 150)
Hex	1B 43 00 nh	(nh = 01h to 96h)

This command sets the page length to n inches. To use this command, send the 120D+ ESC C followed by CHR$(0) and then the ASCII code for the number of inches you want, from 0 to 150. For example, CHR$(27) "C" CHR$(0) CHR$(7) sets the page length to 7 inches, a typical length for many computer forms. Line spacing has no effect on the page length set in inches.

Example:

```
10      LPRINT CHR$(27); "C"; CHR$(0); CHR$(2);
20      FOR N = 1 TO 2
30      LPRINT "CUSTOMER NUMBER:"; CHR$(9); "ORDER NUMBER:"
40      LPRINT CHR$(12); : NEXT
50      LPRINT CHR$(27); "C"; CHR$(0); CHR$(3);
```

```
CUSTOMER NUMBER:          ORDER NUMBER:
```

```
CUSTOMER NUMBER:          ORDER NUMBER:
```

NOTE: When you run the program above, you will see the information printed twice, three inches apart. Line 40 resets the page length to 11 inches.

Margins

The 120D+ has four commands that let you set the margins on your page. In order for these commands to work properly, the 120D+ must know where the top of the page is. Therefore, always make sure the top of the page is lined up with the metal ribbon guide when you turn on the 120D+.

Top and bottom margins

	ON	**OFF**
BASIC	CHR$(27) "N" CHR$(n) (n = 1 to 127)	CHR$(27) "0"
Hex	1B 4E nh (nh = 01h to 7Fh)	1B 4F

The top/bottom margin command, ESC N, is sometimes called the skip-over-perforation command. It sets the number of lines to skip at the bottom of every page (above the perforation on continuous paper). To use the top/bottom margin command, send ESC N followed by the ASCII code for the number of lines you want to skip. For example, CHR$(27) "N"(6) skips six lines at the bottom of the page.

To set the top margin, first line up the top of the page at the ribbon guide (the first line prints approximately 3/8 inch from the top, which is equivalent to skipping one line.) To increase the top margin, advance the paper the required number of lines — manually or using the LF switch with the 120D+ off-line — and then switch the power off and on to reset the new top of the form.

Now, when you send the ESC N command, add the number of lines in the top margin to the number of lines in the bottom margin and use the sum with ESC N. For example, to get a 6-line margin at the top and bottom of each page, the total number of margin lines is 12. Set the top of the page five lines above the ribbon guide and send the command CHR$(27) "N" CHR$(12).

The ESC 0 (letter 0) command cancels the top/bottom margin or skip-over-perforation. When set with ESC N, the skip-over-perforation feature can also be cancelled by changing the page length or by the master reset command.

Example:

```
10    LPRINT CHR$(27); "C"; CHR$(0)
20    LPRINT CHR$(27); "N"; CHR$(3)
30    FOR I = 1 TO 14
40    LPRINT "LINE NUMBER"; I
50    NEXT
60    LPRINT CHR$(27); "O"
```

```
LINE NUMBER 1
LINE NUMBER 2
LINE NUMBER 3


LINE NUMBER 4
LINE NUMBER 5
LINE NUMBER 6
LINE NUMBER 7
LINE NUMBER 8


LINE NUMBER 9
LINE NUMBER 10
LINE NUMBER 11
LINE NUMBER 12
LINE NUMBER 13


LINE NUMBER 14
```

NOTE: In the program above, a top margin of 1 line is set by moving the paper down one line, then turning the power off and on again. The bottom margin is 2 lines.

Left margin

BASIC	CHR$(27) "l" CHR$(n)	(n = 0 to 255)
Hex	1B 6C nh	(nh = 00h to FFh)

The ESC l (lower case "L") command sets the left margin at column n. Printing starts at column (n + 1). To use it, send ESC 1 followed by the ASCII code for the column number you want. For example, CHR$(27) "l" CHR$(10) sets the left margin at column 10, leaving blank columns (printing will start in column 11). The actual width of the margin is determined by the character width in effect when the margin is set. Later changes in the character width do not affect the width of the margin.

If the margin setting exceeds the maximum number of columns in a line for the character width in effect, the setting is ignored.

Example:

```
10      LPRINT "12345678901234567890123456789O"
20      LPRINT "THE POWER ON LEFT MARGIN"
30      LPRINT "STARTS AT THE LEFT MOST"
40      LPRINT "PRINT POSITION"
50      LPRINT CHR$(27); "l"; CHR$(10);
60      LPRINT "THE LEFT MARGIN NOW STARTS"
70      LPRINT "AT COLUMN(N + 1) WHICH"
80      LPRINT "IS COLUMN 11"
90      LPRINT CHR$(27); "l"; CHR$(0);
100     LPRINT "DEFAULT LEFT MARGIN AGAIN"
```

```
12345678901234567890123456789O
THE POWER ON LEFT MARGIN
STARTS AT THE LEFT MOST
PRINT POSITION
          THE LEFT MARGIN NOW STARTS
          AT COLUMN(N + 1) WHICH
          IS COLUMN 11
DEFAULT LEFT MARGIN AGAIN
```

Right margin

BASIC	CHR$(27) "Q" CHR$(n)	(n = 1 to 255)
Hex	1B 51 nh	(nh = 01h to FFh)

In the Epson configuration, ESC Q sets the right margin at column n. To use it, send ESC Q followed by the ASCII code for the column number you want. For example, CHR$(27) "Q"(70) sets the right margin at 70. This will allow printing up to (and including) column 70. The actual width of the margin is determined by the character width in effect when the margin is set. Later changes in the character width do not affect the width of the margin.

The right margin must be set at least 2 columns greater than the left margin or the setting is ignored. The setting is also ignored if the right margin exceeds the maximum number of columns allowable for the character width in effect at the time.

NOTE: In the IBM Graphics Printer configuration, ESC Q sets the 120D+ off line and is used for diagnostic purposes.

Example:

```
10      LPRINT "12345678901234567890123456789O"
20      LPRINT CHR$(27); "Q"; CHR$(15);
30      FOR I = 1 TO 60
40      LPRINT "X";
50      NEXT
60      LPRINT

12345678901234567890123456789O
XXXXXXXXXXXXXXX
XXXXXXXXXXXXXXX
XXXXXXXXXXXXXXX
XXXXXXXXXXXXXXX
```

CHAPTER 6
USING TABS

You have probably used tabs on a typewriter and know that you can use them to move quickly across the page. Tabs on the 120D+ work in much the same way — with a few added features. In addition to horizontal tabs that move across the page, the 120D+ also has vertical tabs that move down the page.

HORIZONTAL TABS

Horizontal (and vertical) tabs can be set in two different ways: as fixed tabs, and as variable tabs. You can also move a distance relative to your current position with a relative htab. In this manual, horizontal tabs are referred to as *htabs*.

Move to next htab

BASIC	CHR$(9)
Hex	09

CHR$(9) moves the printing to the next tab setting. If your computer has difficulty with CHR$(9), you can use the high-bit equivalent, CHR$(137). Either one will work. Power-on default htab settings are every 8 columns — printing will start with column 8, 17, 25, and so on.

Horizontal tabs are convenient for working with forms and columns of numbers. Their position is determined by the pitch in effect at the time the tabs are set, but once set, they do not change with changes in pitch or character width.

Example:

```
10      FOR N = 1 TO 6
20      LPRINT CHR$(137); "HTAB";
30      NEXT
40      LPRINT CHR$(27); "!"; CHR$(5)
50      FOR N = 1 TO 6
60      LPRINT CHR$(137); "HTAB";
70      NEXT
80      LPRINT : LPRINT CHR$(27); "@";
90      END
```

```
HTAB    HTAB    HTAB    HTAB    HTAB    HTAB
HTAB    HTAB    HTAB    HTAB    HTAB    HTAB
```

NOTE: In the program above, notice that the default htab settings remain the same even though elite compressed is selected with the master print command in line 40.

Set fixed tabs

BASIC	CHR$(27) "e" CHR$(0) CHR$(n)	(n = 2 to line length)
Hex	1B 65 00 nh	(nh = 02h to line length)

When you first turn on the 120D+ there are horizontal tabs set at every eight columns — at column 8, 16, 24, and so on. If you want htabs to be set to other columns, you can change them with the command ESC e CHR$(0) followed by the ASCII code for the tab interval you want, from 2 to the current line length. For example, to set fixed htabs at every sixth column, send the command CHR$(27) "e" CHR$(0) CHR$(6).

Example:

```
10      LPRINT CHR$(27); "e"; CHR$(0); CHR$(6)
20      FOR n = 1 TO 9
30      LPRINT CHR$(137); "HTAB";
40      NEXT
50      LPRINT CHR$(27); "!"; CHR$(5)
60      FOR n = 1 TO 9
70      LPRINT CHR$(137); "HTAB";
80      NEXT
90      LPRINT : LPRINT CHR$(27); "@"
100     END
```

```
HTAB  HTAB  HTAB  HTAB  HTAB  HTAB  HTAB  HTAB  HTAB
HTAB  HTAB  HTAB  HTAB  HTAB  HTAB  HTAB  HTAB  HTAB
```

NOTE: In the program above, notice that the fixed htab settings remain the same even though elite compressed is selected with the master print command in line 40.

Variable htabs

BASIC	CHR$(27) "D" CHR$(n1) CHR$(n2) . . . . . CHR$(0)	(n = 1 to 137)
Hex	1B 44 n1h n2h 00	(nh = 01h to 89h)

If you don't want your tabs spaced evenly across the page, then you can use the 120D+'s variable htab command, ESC D. With the variable htab command you can set up 32 tabs at any column you like, from column 1 to 137. To use the command, send the 120D+ ESC D followed by the ASCII code for each tab position you want, from 1 to 137. After the last tab position, send CHR$(0) to end the sequence. For example CHR$(27) "D" CHR$(5) CHR$(18) CHR$(37) CHR$(0) sets htabs at columns 5, 18 and 37.

The column numbers for variable htabs must be given in ascending numerical order. A sequence such as CHR$(5) CHR$(37) CHR$(18), for example, would set tabs at column 5 and 37 only. The 120D+ interprets any code less than the previous one as the ending code for the sequence. In this case CHR$(18) would be the ending code.

Using the variable htab command cancels any fixed or variable htabs that were previously set. If you want to return to fixed htabs, you must either set them again with a fixed htab command or reinitialise the printer to reset the default htabs.

Example:

```
10      LPRINT CHR$(27); "D"; CHR$(5); CHR$(18); CHR$(37); CHR$(0)
20      FOR N = 1 TO 3
30      LPRINT CHR$(137); "HTAB";
40      NEXT
50      LPRINT CHR$(27); "!"; CHR$(5)
60      FOR N = 1 TO 3
70      LPRINT CHR$(137); "HTAB";
80      NEXT
90      LPRINT : LPRINT CHR$(27); "@"
100     END
```

```
    HTAB          HTAB                HTAB
    HTAB          HTAB                HTAB
```

NOTE: In the program above, notice that the variable htab setings remain the same even though elite compressed is selected with the master print command in line 40.

Relative htab

BASIC	CHR$(27) "f" CHR$0 CHR$ (n)	(n = 0 to 127)
Hex	1B 66 00nh	(nh = 00h to 7Fh)

If you only need to move across the page one time, ESC f CHR$(0) moves the print head any number of columns to the right from the current position. This is why it's called *relative:* it moves a number of spaces in relation to the print head's current position on the page (fixed and variable htabs are absolute: column 12, for example, is always in the same place on the page, no matter where the print head happens to be). It is the equivalent of printing a number of spaces.

To use the relative htab command, send the 120D+ ESC f CHR$(0) followed by the ASCII code for the number of columns you want to move, from 0 to 127.

Example:

```
10      FOR N = 1 TO 5
20      LPRINT "WIDENING"; CHR$(27); "f"; CHR$(0); CHR$(N); "GAPS"
30      NEXT
40      LPRINT CHR$(27); "!"; CHR$(5)
50      FOR N = 1 TO 5
60      LPRINT "WIDENING"; CHR$(27); "f"; CHR$(0); CHR$(N); "GAPS"
70      NEXT
80      END
```

```
WIDENING GAPS
WIDENING  GAPS
WIDENING   GAPS
WIDENING    GAPS
WIDENING     GAPS

WIDENING GAPS
WIDENING  GAPS
WIDENING   GAPS
WIDENING    GAPS
WIDENING     GAPS
```

NOTE: In the program above, notice that the relative htab settings *do not* remain the same when elite compressed is selected with the master print command in line 40. This is because the htab is now a *relative* distance rather than an *absolute* distance.

DOT TABS

The 120D+ has another type of horizontal tab to move the print head across the page. It's called a dot tab. These work in much the same way as the other horizontal tabs, except instead of tabbing to a specified character printing position, the 120D+ tabs to a particular dot column.

There are 60 columns of dots per inch which, of course gives you much finer precision in your horizontal tabbing. Dot tabs can be used for very fine spacing increments (for justified text, perhaps) or even for printing a line or a character between other characters.

There are two types of dot tabs: *absolute* dot tabs and *relative* dot tabs.

Absolute dot tabs

BASIC	CHR$ (27) "$" CHR$(n1) CHR$(n2) (n1 and n2 specify the tab position in dots)
Hex	1B 24 n1h n2h (n1h and n2h specify the tab position in dots)

Absolute dot tabs move the print head to the location on the page that is the specified number of dot columns from the left end of the line. They will do this regardless of where the print head is currently located on the line.

The format of the command is ESC $ CHR$(n1) CHR$(n2) where n1 and n2 are used to define the dot column to tab to. To determine the values to use for n1 and n2, divide the desired dot column by 256. The integer portion of the quotient becomes n2; the remainder is n1. You can use these BASIC statements to calculate n1 and n2, where n is the desired dot column:

```
N1 = N MOD 256
N2 = N \ 256          (\ is integer division; this is
                       equivalent to INT (N\256) in BASIC)
```

At 60 dot columns per inch, the 120D+ has 480 columns. If you specify a dot column beyond right margin, the results are unpredictable. The maximum value for n1 is 224; the maximum value for n2 is 1 (if n2 is less than 1, however, then the maximum value for n1 is 255).

Example:

```
10      FOR I = 0 TO 360 STEP 60
20      LPRINT CHR$(27); "$"; CHR$(I MOD 256); CHR$(I \ 256); (I / 60);
30      NEXT I
40      LPRINT
50      FOR I = 0 TO 360 STEP 60
60      LPRINT CHR$(27); "$"; CHR$(I MOD 256); CHR$(I \ 256); "!";
70      NEXT I
80      LPRINT CHR$(15)
90      FOR I = 0 TO 360 STEP 60
100     LPRINT CHR$(27); "$"; CHR$(I MOD 256); CHR$(I \ 256); (I MOD 256); (I \
256);
110     NEXT I
120     LPRINT
130     LPRINT CHR$(18)
140     END
```

```
 0          1          2          3          4          5          6
:          :          |          |          |          :          |
0 0        60 0       120 0      180 0      240 0      44 1       104 1
```

NOTE: The program above uses absolute dot tabs to print an inch ruler (the printout is reduced in this book). To demonstrate that the dot columns stay in fixed positions regardless of character pitch, the top two lines are printed in pica pitch, and the bottom line in compressed. You will note that the three lines don't seem to align perfectly. Actually they do, but it is a quirk of BASIC which places a space (which you can't see, of course) before each number that prints.

Relative dot tabs

BASIC	CHR$(27) "\" CHR$(n1) CHR$(n2) (n1 and n2 specify the tab position in dots)
Hex	1B 92h n1h n2h (n1h and n2h specify the tab position in dots)

Relative dot tabs move the print head to the location on the page that is the specified number of dot columns relative to its current position. They will do this regardless of where the print head is currently located on the line.

The format of the command is ESC \CHR$(n1) CHR$(n2) where n1 and n2 are used to define the dot column to tab to. The values for n1 and n2 are calculated just as they are with the absolute dot tab command (described above).

The relative dot command spaces in one-half dot columns, or 1/120 inch (compared to one dot columns, or 1/60 inch, with the absolute dot command). At 120 dot columns per inch, the 120D+ has up to 960 columns. If you specify a dot columns beyond the right margin, the results are unpredictable. The maximum value for n1 is 192; the maximum value for n2 is 3 (if n2 is less than 1, however, then the maximum value for n1 is 255).

Example:

```
10      FOR I = 0 TO 20 STEP 2
20      REL$ = CHR$(27) + "\" + CHR$(I) + CHR$(0)
30      LPRINT "This "; REL$; "shows "; REL$; "increasing "; REL$; "wordspace"
40      NEXT I
50      END
```

```
This shows increasing wordspace
This shows increasing wordspace
This shows increasing wordspace
This shows increasing wordspace
This shows increasing wordspace
This shows increasing wordspace
This shows increasing wordspace
This shows increasing wordspace
This shows increasing wordspace
This shows increasing wordspace
This shows increasing wordspace
```

VERTICAL TABS (VTABS)

Vertical (and horizontal) tabs can be set in two different ways: as fixed tabs, and as variable tabs. You can also move a distance relative to your current position with a relative vtab. Still another command lets you set vertical tab channels for flexibility with multi-page forms. In this manual, vertical tabs are referred to as vtabs.

Move to next vtab

BASIC	CHR$(11)
Hex	0B

Vertical tabs move down the page by lines. They are useful when working with forms or to leave space for pictures or diagrams in your text. Vtabs are unaffected by changes in line spacing. The spacings for vtabs is determined by the line spacing in effect when they are set. If the line spacing is later changed, the vtabs are unaffected.

The 120D+'s vtab command is CHR$(11). You may also use the high-bit ASCII equivalent, CHR$ (139). Unlike horizontal tabs, vtabs have no default settings. When you first turn on the 120D+, a vtab will advance the paper one line.

Example:

```
10        FOR n = 1 TO 4
20        LPRINT CHR$(137); "DEFAULT VTAB"
30        NEXT


          DEFAULT VTAB
          DEFAULT VTAB
          DEFAULT VTAB
          DEFAULT VTAB
```

Fixed vtabs

BASIC	CHR$(27) "e" CHR$(1) CHR$(n) (n = 1 to page length)
Hex	1B 65 01 nh (nh = 01h to page length)

This command sets fixed vtabs at intervals of whatever number of lines you like. Send the 120D+ ESC e CHR$(1) followed by the ASCII code for the vtab interval you want in lines, from 1 to the page length in lines. For example, to set vtabs every 6 lines, send the command CHR$ (27) "e" CHR$(1) CHR$(6).

Example:

```
10        LPRINT CHR$(27); "e"; CHR$(1); CHR$(3);
20        FOR N = 1 TO 3
30        LPRINT CHR$(11); "VTAB No."; N; "AT LINE"; 3 * N
40        NEXT N
50        LPRINT : LPRINT CHR$(27); "@"
60        END



VTAB No. 1 AT LINE 3

VTAB No. 2 AT LINE 6

VTAB No. 3 AT LINE 9
```

Variable vtabs

BASIC CHR$(27) "B" CHR$(n1) CHR$(n2) . . . . . CHR$(0)
(n = 1 to 255)
Hex 1B 42 n1h n2h 00
(nh = 01h to FFh)

If you don't want fixed vertical tabs, you can set up to 16 vtabs at any line number from 1 to 255 that you like using the variable vtab command, ESC B. To use the command, send the 120D+ ESC B followed by the ASCII code for the line number of each vtab position you want, from 1 to 255. After the last tab position, send CHR$(0) to end the sequence. For example, CHR$(27) "B" CHR$(6) CHR$(20) CHR$(26) CHR$(0) sets vtabs at lines 6, 20 and 26.

The line numbers for variable vtabs must be given in ascending numerical order. A sequence such as CHR$(6) CHR$(26) CHR$(20), for example, would set tabs at column 6 and 26 only. The 120D+ interprets any code less than the previous one as the ending code for the sequence. In this case, CHR$(20) would be the ending code.

Using the variable vtab command cancels any fixed or variable vtabs that were previously set. If you want to return to fixed vtabs, you must set them again with a fixed vtab command.

Example:

```
10      LPRINT CHR$(27); "B"; CHR$(6); CHR$(20); CHR$(26); CHR$(0);
20      FOR N = 1 TO 3
30      LPRINT CHR$(11); "VTAB"
40      NEXT N
50      LPRINT : LPRINT CHR$(27); "@"
60      END
```

```
VTAB
```

```
VTAB
```

Relative vtab

BASIC	CHR$(27) "f" CHR$(1) CHR$(n)	(n = 0 to 127)
Hex	1B 66 01 nh	(nh = 00h to 7Fh

If you only need to move down the page one time, ESC f CHR$(1) advances the paper any number of lines. This is why it's called *relative;* it moves a number of lines in relation to current paper position (fixed and variable vtabs are absolute; line 10, for example, is always in the same place on the page, no matter where the paper happens to be). It is the equivalent of printing a number of line feeds.

To use the relative vtab command send the 120D+ ESC f CHR$(1) followed by the ASCII code for the number of lines you want to move, from 0 to 127.

This command is also an easy way to leave a fixed space (for a picture to be inserted later perhaps) without having to figure out where you are on the page.

Example:

```
10      FOR N = 1 TO 5
20      LPRINT "LINE"; N; CHR$(27); "f"; CHR$(1); CHR$(N)
30      NEXT N
40      END
```

```
LINE 1

LINE 2


LINE 3



LINE 4



LINE 5
```

Vtab channels

If you work with multi-page forms you may find that you need a different set of vtabs for each page. In the Epson configuration, the 120D+ provides a way to save up to eight sets of vtabs and recall them with a single command as you need them. Each set of vtabs is called a channel and is identified by a number from 0 to 7.

Define vtab channel

BASIC CHR$(27) "b" CHR$(N) CHR$(n1) CHR$(n2) . . . . CHR$(0)
(N = 0 to 7; n = 1 to 255)
Hex 1B 62 Nh n1h n2h 00
(Nh = 00h to 07h; nh = 01h to FFh)

To use vtab channels in the Epson FX configuration, you must first *define* the vtabs for each channel you want to use. To do this, send the 120D+ ESC b followed by the ASCII code for the channel number, from 0 to 7, followed by the ASCII code for the line number of each vtab position you want, from 1 to 255. After the last position, send CHR$(0) to end the sequence.

For example, to define channel 1 to contain vtabs at lines 6, 10, and 14, and channel 2 to contain vtabs at lines, 4, 7, 17, and 38, send the commands: CHR$(27) "b" CHR$(1) CHR$(6) CHR$ (10) CHR$(14) CHR$(0) and CHR$(27) "b" CHR$(2) CHR$(4) CHR$(7) CHR$(17) CHR$(38) CHR$(0).

Channel 0 is the default channel. Unless you tell it otherwise, the 120D+ will use the vtabs that are defined in that channel. (Vtabs set with the command ESC B are automatically placed in channel 0.) Vtab channels are selected with the ESC / command, described and illustrated below.

Select vtab channel

BASIC CHR$(27) "/"
Hex 1B 2F

The vtab channel is defined with the ESC b command (described above). A vtab channel is a set of up to 16 previously defined vtabs. Up to eight channels, numbered 0 to 7, can be defined. To *select* a vtab channel in the Epson FX configuration (see note below), use the command ESC / followed by the ASCII code for the number of the channel you want, from 0 to 7. For example, to select vtab channel 2, use the command LPRINT CHR$(27) "/" CHR$(2). Any subsequent vtab command will use the vtabs defined in channel 2.

This command is valid in Epson configuration only.

NOTE: In the IBM Graphics Printer configuration, ESC / is used to print control codes as characters when creating your own download characters.

Example:

```
NEW
10 LPRINT CHR$(27); "b"; CHR$(0); CHR$(5); CHR$(8); CHR$(20),
CHR$(0)
20 LPRINT CHR$(27); "b"; CHR$(1); CHR$(3); CHR$(10); CHR$(12);
CHR$(0)
30 LPRINT CHR$(27); "b"; CHR$(2); CHR$(18); CHR$(24); CHR$(30);
CHR$(0)
40 FOR I = 0 TO 2
50 LPRINT CHR$(27); "/"; CHR$(1);
60 FOR N = 1 TO 3
70 LPRINT CHR$(11); "VTAB"; N; "IN CHANNEL"; I;
80 NEXT N
90 LPRINT CHR$(12);
100 NEXT I
```

NOTE: Before you run the program above, make sure the top of your paper is lined up with the ribbon guide. You will see three pages of output on the 120D+ with three vtabs identified on each page.

CHAPTER 7
GRAPHICS

As applied to computers and printers, "graphics" means anything that is not a letter, number, or symbol generally found on a typewriter or word processor. Graphics includes everything from lines, boxes, border designs and special logos, to graphs and complete drawings that are limited only by your imagination.

The 120D+ can print graphics in two different ways. The first method uses predefined characters called block and line graphics characters. It is handy for designing forms, creating boxes, drawing lines and so on. The second method, called dot graphics, allows you to specify exactly where each and every dot will be printed. It involves a little more work in planning and programming, but the results are worth it.

LINE AND BLOCK GRAPHICS

The 120D+ contains two groups of block and line graphics characters — one in its Epson character set at ASCII 128 to 159, and one in its IBM character set at ASCII 169 to 223. You can see a complete list of the characters in both sets in Apendix B.

Both of these groups contain line-drawing characters — but with one big difference. The characters in the Epson character set are 7 dots high; to connect the characters in one line to those in the next line you must set the line spacing to 7/72-inch. The characters in the IBM character set, on the other hand, are based on 12-dots; you can connect them using standard 6 lines-per-inch (12/72-inch) line spacing. (The IBM characters also work with 7/72-inch line spacing by overlapping).

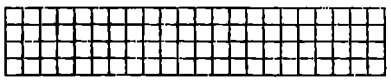
Example:

```
10      LPRINT "AT 7/72 INCH LINE SPACING :": I = 0
20      LPRINT CHR$(27); "A"; CHR$(7)
30      LPRINT CHR$(27); "m"; CHR$(4)
40      LPRINT CHR$(27); "U1";
50      LPRINT "EPSON CHARACTER SET"
60      LPRINT CHR$(135);
70      FOR N = 1 TO 21: LPRINT CHR$(130); : NEXT
80      LPRINT CHR$(136)
90      FOR K = 1 TO 3
100     LPRINT CHR$(132);
110     FOR N = 1 TO 21: LPRINT CHR$(128); : NEXT
120     LPRINT CHR$(131)
130     NEXT K
140     LPRINT CHR$(137);
150     FOR N = 1 TO 21: LPRINT CHR$(129); : NEXT
160     LPRINT CHR$(138)
170     REM IBM CHARACTER SET
180     LPRINT CHR$(27); "^51"
190     LPRINT "IBM CHARACTER SET"
200     LPRINT CHR$(218);
210     FOR N = 1 TO 21: LPRINT CHR$(194); : NEXT
220     LPRINT CHR$(191)
230     FOR K = 1 TO 3
240     LPRINT CHR$(195);
250     FOR N = 1 TO 21: LPRINT CHR$(197); : NEXT
260     LPRINT CHR$(180)
270     NEXT K
280     LPRINT CHR$(192);
290     FOR N = 1 TO 21: LPRINT CHR$(193); : NEXT
295     LPRINT CHR$(217)
300     LPRINT CHR$(27); "U0";
310     LPRINT CHR$(27); "^50"
320     IF I THEN END
```

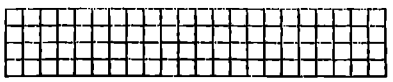
```
330     LPRINT "AT 12/72 INCH LINE SPACING:"
335     LPRINT CHR$(27); "A"; CHR$(12);
340     I = 1: GOTO 30
350     END
```

```
AT 7/72 INCH LINE SPACING :

EPSON CHARACTER SET
```

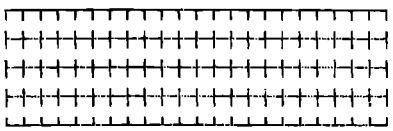


```
IBM CHARACTER SET
```

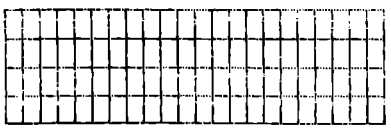


```
AT 12/72 INCH LINE SPACING:

EPSON CHARACTER SET
```



```
IBM CHARACTER SET
```



In the program above, line 30 points out another difference between line graphics in the Epson character set and those in the IBM character set. As we discussed at the end of Chapter 4, the 120D+ can interpret ASCII codes 128 to 159 in one of two ways: as control codes or as graphic characters. To use them as graphic characters you must first tell the 120D+ with the command ESC "m" CHR$(4) (or by turning on internal switch 4 when in the Epson 2 configuration).

The IBM character set line graphics, however, use a different ASCII code range (169 to 223). In the IBM character set, these ASCII codes are always line graphics. Once you select the IBM configuration (with the command ESC "~51" or by turning on internal switches 2 and 3), the line graphics characters are ready to use without any other command.

DOT GRAPHICS

When you send the 120D+ a code for a character, it prints the character using a pattern of dots stored in its memory. To print a pattern of dots that the 120D+ does not have in its memory — a drawing or character you designed yourself, for example, you need to control the individual dots that are printed. This technique is called *dot graphics*.

As you may recall from Chapter 2, the print head consists of nine pins stacked one above the other. The print head can therefore print columns of up to nine dots at a time. For most graphics applications, however, the bottom pin in the print head is not used because most computers communicate with their printer using a parallel interface, which can send just eight pieces (bits) of information at a time. (Using the ninth pin is discussed later in this chapter).

The 120D+ prints dot graphics in lines, just as it does predefined characters. The print head moves across the paper striking the appropriate pins against the ribbon, forming a columns of dots on each line. Tall graphics figures are printed by adjusting the line spacing and printing several lines until the figure is complete.

However, with dot graphics the line length and dot spacing are not fixed as they are with predefined characters. To use dot graphics, you must tell the 120D+ three things *for each line:* (1) which pins to print in each column; (2) how closely to space the columns, called the *graphics density*; and (3) how many columns there will be in the line.

Graphics commands

The graphics commands perform three functions: they tell the 120D+ to interpret the ASCII codes that follow as print head pin number data instead of characters, they set the graphics density, and they set the number of columns per line, which tells the 120D+ how many pieces of data to expect. First, let's see how the 120D+ prints graphics.

Pin numbers

To tell the 120D+ which pins to print in each column, you need a way to identify the pins in the print head. The 120D+ assigns each pin a number as shown in Figure 7-1. Skipping the unused bottom pin, they are numbered as powers of 2: 2^0, 2^1, 2^2, ..., 2^7, or in everyday numbers, 1, 2, 4, 8, 16, 32, 64 and 128. Once you have told the 120D+ you are using dot graphics with one of the graphics commands, you tell it which pins to print by sending the ASCII code that corresponds to the pin number — one code for each column.

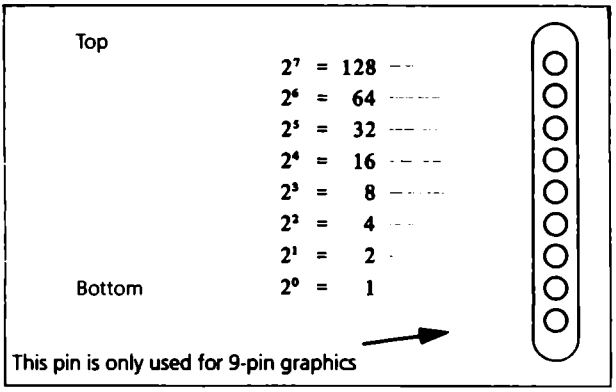


Figure 7-1. Print head numbers.

Whey aren't the pins just numbered 1 to 8? Because by using powers of two, the sum of any combination of pin numbers is a unique number. In other words, any number from 1 to 255 represents a unique combination of pin numbers. Thus, you can print any combination of pins by sending the ASCII code that corresponds to the sum of the pin numbers. For example to print pins 1, 2 and 4, send ASCII 7 (1 + 2 + 4 = 7); to print pins 4, 8 and 64, send ASCII 76; and to print all eight pins. send ASCII 255.

NOTE: Apple users and others whose computers send only seven bits of data cannot send numbers greater than 127 and therefore cannot print the top pin, number 128. This means that when you design graphics, you can use only seven dots per line. For compatibility with 7-bit computers, all of the graphics in the example programs in this manual are designed this way.

Graphics density

Changing graphics densities is similar to changing character widths when printing text. The same number of dots are printed, but the density that you select determines how close together the dots are printed. Here are the four graphics commands that select each density:

Single density graphics

BASIC	CHR$(27) "K" CHR$(n1) CHR$(n2)
Hex	1N 4B n1h n2h

Single density graphics print at 60 dots per inch with a line length of n1 + (256 x n2).

Double density graphics

BASIC	CHR$(27) "L" CHR$(n1) CHR$(n2)
Hex	1B 4C n1h n2h

Double density graphics print at 120 dots per inch with a line length of n1 + (256 x n2).

High-speed double density

BASIC	CHR$(27) "Y" CHR$(n1) CHR$(n2)
Hex	1B 59 n1h n2h

High-speed double density graphics print at 120 dots per inch with a line length of n1 + (256 x n2).

Quadruple density graphics

BASIC	CHR$(27) "Z" CHR$(n1) CHR$(n2)
Hex	1B 5A n1h n2h

High-speed double density graphics print at 240 dots per inch with a line length of n1 + (256 x n2).

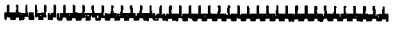
Comparing graphics densities

Now that you know what the formats are to select these graphics densities, let's compare them by printing a graphics program. Try the following program:

Example:

```
10      WIDTH "LPT1:", 255
20      LPRINT "SINGLE DENSITY :"
30      LPRINT CHR$(27); "K"; CHR$(120); CHR$(0); : GOSUB 110
40      LPRINT "DOUBLE DENSITY :"
50      LPRINT CHR$(27); "L"; CHR$(120); CHR$(0); : GOSUB 110
60      LPRINT "HIGH SPEED DOUBLE DENSITY :"
70      LPRINT CHR$(27); "Y"; CHR$(120); CHR$(0); : GOSUB 110
80      LPRINT "QUADRUPLE DENSITY :"
90      LPRINT CHR$(27); "Z"; CHR$(120); CHR$(0); : GOSUB 110
100     END
110     FOR N = 1 TO 40: LPRINT CHR$(7); CHR$(62); CHR$(7); : NEXT
120     LPRINT : LPRINT
130     RETURN
```

```
SINGLE DENSITY :
```



```
DOUBLE DENSITY :
```

```
HIGH SPEED DOUBLE DENSITY :
```

```
QUADRUPLE DENSITY :
```

In the program above, each line is set to contain 120 columns of dots by the codes CHR$(120) CHR$(0) in lines 20, 40 and 60 (see the next section). Line 100 defines a three-column pattern of pin numbers — pins 1 + 2 + 4 = 7 in column one, pins 2 + 4 + 8 + 16 + 32 = 62 in column 2, and then pins 1 + 2 + 4 = 7 again in column three — and prints the pattern 40 times to get a total of 120 columns. At single density of 60 dots per inch, the pattern is 2 inches long. At double density of 120 dots per inch, 1 inch. And at quadruple density of 240 dots per inch, 1/2 inch.

Notice the difference between the pattern printed in double density and the one printed in low-speed double density. In double density and in quadruple density, columns are spaced only 1/2 and 1/4 dot from each other. The columns actually overlap as shown in Figure 7-2. At this spacing, the print head moves too fast to print the same pins in two adjacent columns. If the graphics figures calls for the same pins in two adjacent columns as the example program does (every third and fourth column call for pins 1, 2, and 4), the pins in the adjacent columns are ignored. If you look closely at the double density pattern printed in the example program, you can see that columns 4, 7 and so on are missing.

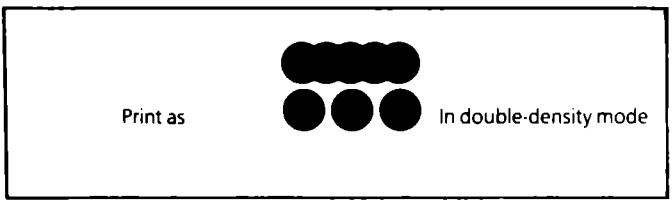


Figure 7-2. Double and quadruple densities.

Since the columns are spaced so close together, these missing columns are not normally noticeable. But for those cases where printing the same pins in two adjacent columns is critical, the 120D+ provides a special low-speed double density mode. In this mode, the print head moves slowly enough to print the same pins in adjacent columns. The trade-off is the slower speed. When printing larger graphics figures, the difference in print time at double density and at low-speed double density can be considerable. In quadruple density, the columns are too close together to print the same pin numbers in adjacent columns even at a slower speed. Therefore, there is no low-speed quadruple density.

SENDING GRAPHICS DATA

When you send one of the graphics commands, you tell the 120D+ to interpret the codes that follow as pin values instead of characters and commands. The 120D+ must know how many codes to interpret this way and when to resume interpreting codes as commands and characters.

Line length: number of columns

To send the correct graphics data, you must follow the graphics command with two ASCII codes that specify the number of columns in the dot graphics line, CHR$(*n*1) and CHR$(*n*2).

Why two numbers? Consider the maximum number of columns that can be printed in a line. At 60 dots per inch, the 120D+ can print 480 columns of dots in an 8-inch line. And at 240 dots per inch, the 120D+ can print 1,920 columns in a line! But the largest number BASIC can send is 255. Obviously, you need a way to send larger numbers.

The 120D+ solves this problem by using the two numbers *n*1 and *n*2 together to determine the number of columns in a line. The first number, *n*1, indicates the number of columns from 0 to 255. The second number *n*2, indicates the number of times 256 is to be added to the first number. With this scheme you can send any size number you need. For example:

```
  100 = 100 + 0 x 256 n1 = 100, n2 = 0
  480 = 224 + 1 x 256 n1 = 224, n2 = 1
  816 =  48 + 3 x 256 n1 =  48, n2 = 3
1,920 = 128 + 7 x 256 n1 = 128, n2 = 7
```

NOTE: The largest number that 7-bit computers can send is 127. This means that you can specify only 1 to 127 columns with *n*2 = 0, 256 to 383 columns with *n*2 = 1, and so on. To print figures with widths 128 to 255, 384 to 511, and so on, simply divide the line into two pieces. Print the first half ending the print statement with a semicolon. Then use a second print statement to print the second half on the same line.

You can calculate the values *n*1 and *n*2 for any number of columns you need by dividing the number of columns by 256. The quotient will be *n*2 and the remainder will be *n*1. If you like, you can have your computer calculate *n*1 and *n*2 for you with two statements:

```
N1 = X MOD 256
N2 = INT (X/256)
```

where X is the number of columns. Table 7-1 shows another easy way to calculate *n*1 and *n*2.

TABLE 7-1. CALCULATING *n*1 AND *n*2

If the number of columns, x ranges from:	*n*1 is:	and *n*2 is:
1 to 255	x	0
256 to 511	x - 256	1
512 to 767	x - 512	2
768 to 1023	x - 768	3
1024 to 1279	x - 1024	4
1280 to 1535	x - 1280	5
1536 to 1791	x - 1536	6
1792 to 1920	x - 1792	7

Putting it all together

Now that we know how the graphics commands work, how to control the pins, and how to set the number of columns, let's try a sample program to see some actual graphics.

Example:

```
10      WIDTH LPRINT 255
20      LPRINT CHR$(27); "K"; CHR$(44); CHR$(1)
30      FOR N = 1 TO 298
40      J = N MOD 128
50      IF J = 9 OR J = 13 THEN J = 0
60      LPRINT CHR$(J);
70      NEXT
80      END
```

This program demonstrates several techniques for printing graphics. Line 10 tells BASIC not to add a carriage return every 80 characters as many versions of BASIC do. Line 20 sends the graphics command for single density and sets the graphics line length to 300 columns (44 + 1 x 256). Notice that line 20 ends with a semicolon. If it did not, the carriage return and line feed sent at the end of the line would be interpreted as the first two graphics codes. Lines 30 through 70 form a loop that prints the value for J, which is incremented in line 40, three hundred times. Line 50 eliminates J = 9 and J = 13, thus avoiding printing CHR$(9) and CHR$(13), which are problems for many computers. You can use a similar statement if your computer has trouble with other codes.

Try the previous program again in double density and quadruple density by changing the graphics command in line 20. If yours is an eight-bit computer, you can also change the value in line 40 from 128 to 256, which will allow the top pin, number 128, to print. Experiment by changing the line length in line 20. Be sure to change line 30 to correspond to the new line length.

GRAPHICS FOR SPECIAL APPLICATIONS

The 120D+ has several graphics configurations that can be used for special applications. In addition to the four graphics densities we've covered so far, there are four additional ones, making a total of eight available densities. The four additional densities are especially useful for making screen dumps and for plotting, but they can also be used to just add variety to your graphics.

Master graphic commands

BASIC	CHR$(27) "*" CHR$(m) CHR$(n1) CHR$(n2) (m = 0 to 7)
Hex	1B 2A mh n1 n2h (mh = 00h to 07h)

The master graphics command provides an easy way to select any of the 120D+'s eight densities. Each density is assigned a graphics mode number, from 0 to 7, as shown in Table 7-2. To use the master graphics command send the 120D+ ESC *, followed by the ASCII code for the mode you want, followed by the ASCII codes for the line length.

TABLE 7-2. GRAPHICS DENSITY MODES

Mode	Description	Density	Max. columns per line
0	Single	60 dots per inch	480
1	Double	120 dots per inch	960
2	Hi-speed dbl.	120 dots per inch	960
3	Quadruple	240 dots per inch	1920
4	CRT screen	80 dots per inch	640
5	One-to-one	72 dots per inch	576
6	Hi-res CRT	90 dots per inch	720
7	Two-to-one	144 dots per inch	1152

Example:

```
10      WIDTH LPRINT 255
20      FOR M = 0 TO 7
30      LPRINT "MODE";
40      LPRINT USING "£££"; M;
50      LPRINT CHR$(27); "*"; CHR$(M); CHR$(120); CHR$(0);
60      FOR N = 1 TO 60
70      LPRINT CHR$(85); CHR$(42);
80      NEXT N: LPRINT
90      NEXT M
```

```
MODE 0
MODE 1
MODE 2
MODE 3
MODE 4
MODE 5
MODE 6
MODE 7
```

Change graphic density

BASIC	CHR$(27) "?" CHR$(m)	(m = 0 to 6)
Hex	1B 3F mh	(mh = 00h to 06h)

The 120D+ also provides a way to quickly change from one graphics density to another without having to redefine the line length, as you did with the ESC + command. Each density is selected by sending the 120D+ ESC ?, followed by the ASCII code for the mode you want as shown in Table 7-2.

Nine-pin graphics

BASIC	CHR$(27) "^ " CHR$(m) CHR$(n1) CHR$(n2)
Hex	1B 5E mh n1h n2h

At the beginning of this chapter we mentioned that the bottommost pin on the print head was not normally used for graphics. It is possible to use this ninth pin, although it requires a little more programming.

The nine-pin graphics mode has the advantage of being a little faster than the normal seven- or eight-pins mode since it prints nine dots at a time instead of seven or eight. The disadvantages are that only single and double density are available with nine pins, and that it requires twice as much data — two ASCII codes for each column of dots.

In nine-pin graphics, the first data code determines the pattern of the top eight pins in the usual way. The second code determines whether the bottom pin is printed: a code 128 or greater prints the bottom pin; a code less than 128 does not print the bottom pin. Because of this, nine-pin graphics is not used for routine applications. But for very intense graphics applications such as screen dumps and plotter graphics, the increase in speed may make the additional programming effort worthwhile.

The nine-pin graphics command is ESC^ . To use it send the 120D+ ESC^ , followed by CHR$(0) for single density or CHR$(1) for double density, followed by the usual CHR$(*n*1) and CHR$(*n*2) to set the line length.

DESIGNING GRAPHICS

Graphics can be designed in two ways. In the first method you define the shapes by sketching them on paper and then tell the 120D+ the exact pin numbers to print in each column. In the second method, sometimes called plotting, the shapes and pin numbers are calculated by the computer according to a formula you supply in a program.

Defined shapes

Any graphic pattern can be defined using graph paper as shown in Figure 7-3. Each horizontal row on the graph paper corresponds to a pin number and each vertical column corresponds to a column of dots. You simply sketch the shape you want on the paper and note the blocks where dots are to be printed. Then add the required pin numbers in each column to determine the pin number codes.

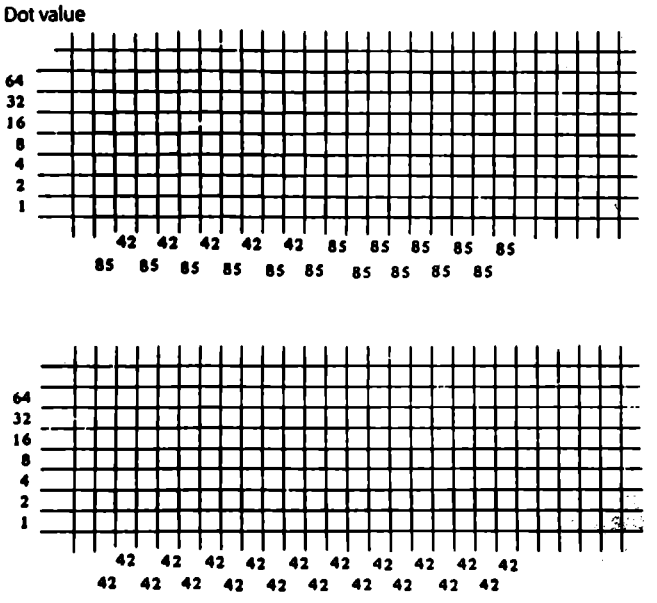


Figure 7-3. Designing a graphic figure.

You then print your defined shape using a program with the pin number codes placed in data statements. The program reads the codes, usually accumulating them in a string variable, and prints the shape exactly as you defined it. The following program prints the design shown in Figure 7-3 and demonstrates the technique.

Example:

```
10      WIDTH LPRINT 255
20      LPRINT CHR$(27); "1";
30      FOR N = 1 TO 20
40      READ X
50      FLAG$ = FLAG$ + CHR$(X)
60      NEXT
70      LPRINT CHR$(27); "K"; CHR$(20); CHR$(0); FLAG$
80      FLAG$ = ""
90      FOR N = 1 TO 20
100     READ X
110     FLAG$ = FLAG$ + CHR$(X)
120     NEXT
130     LPRINT CHR$(27); "K"; CHR$(20); CHR$(0); FLAG$
140     DATA 85,42,85,42,85,42,85,42,85,42
150     DATA 85,85,85,85,85,85,85,85,85,85
160     DATA 42,42,42,42,42,42,42,42,42,42
```

The letters are printed in two lines — first the top half of the flag and then the bottom half. In order to make the halves meet, the line spacing is set to 7/72" in line 20. Lines 30 through 60 form a loop that reads the 20 pin numbers that form the top half of the flag from the data statements and accumulates them in the variable FLAG$. Line 70 then sets a single density graphics line 20 columns wide and prints FLAG$. After clearing FLAG$ in line 80, lines 90 through 130 repeat the procedure for the bottom half of the flag.

Notice the data statements in the program. Even relatively small graphic patterns require a considerable amount of data. For example, our program uses 40 pieces of data to print a small flag. You can appreciate why so much data is required when you consider the number of positions you can place dots on an 8-1/2 x 11-inch page — 380,160! And that's using single density.

Some computers have programs available that calculate the graphics data for you. The programs allow you to draw on the screen using a mouse, graphics tablet, or light pen, and then "dump" the screen to the printer. If you plan to print large amounts of complex graphics, such a program can be worthwhile.

Calculated shapes (plotting)

Another way to ease the task of defining graphic shapes is to let your computer design the shapes for you. This is how computer plotters work, and your 120D+ can function as a plotter too. Any shape that can be defined by a mathematcial equation can be calculated and plotted on the 120D+.

Plotting calculated shapes generally requires some fairly advanced programming skills, which are beyond the scope of this manual. To get you started, however, we'll describe some general programming approaches and show you one program that produces a shape we call a "squiggle."

Plotting programs set aside a part of the computer's memory to store the dots you want to print. In computer terms, that means setting up an array. In effect, the array is the computer's graph paper."

The first thing to do in setting up an array is to define the size — called "dimensioning the array." Like graph paper, the array must have two dimensions. One is the horizontal dimension (the number of columns of dots), and the other is the vertical dimension (the number of printing lines).

As with defined shapes, the next step is to mark which dots are to be printed. This is done by the program. As it calculates the shape, it changes the values in the appropriate array locations from zero to the necessary pin numbers.

When all the points in the shape have been calculated and their pin numbers stored in the array, the final step prints the array on the 120D+.

Aside from the programming required, two other limiting factors with calculated shapes are the memory size and the processing speed of you computer. Arrays use up computer memory very quickly. For example, a one-inch square contains 4,320 dot positions. Using 8 dots per column, that is 540 array locations. That may not sound a lot, but since each array location requires at least two bytes of memory, this one-inch square uses up over 1K of memory. To plot an 8 x 8-inch square — less than one page — you'll need over 64K of memory just for the array!

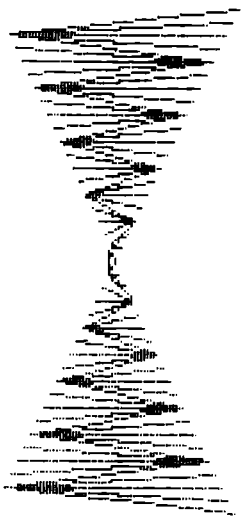
The processing speed of your computer also becomes a consideration when using calculated shapes. Depending on the particular equation and the programming used to calculate it, a shape even only an inch or so square can require tens of thousands of calculations (each calculation does not necessarily fill an array location), and several minutes or even hours of processing time before any results are sent to the printer for plotting. Moreover, the number of required calculations can increase geometrically with the size of the shape. Our simple example program, for example, takes several minutes to run. A program that plots a complex figure the size of the page can easily take hours to run!

Even if you don't understand all of the programming in it, try the following program to see how a graphics plotting program runs. The calculations in the program can take about five minutes, depending on the type of computer you have. To let you know that the program is working you will see the starting and ending points for each line displayed on your screen as they are calculated.

Example:

```
10 REM ------------------------------------------------------------
20 REM              SQUIGGLE PLOTTER
30 REM ------------------------------------------------------------
40 DEFINT A-Z: DIM DOT(200, 33)
100 REM -----------------------------------------------------------
110 REM          CALCULATE THE PATTERN
120 REM -----------------------------------------------------------
130 Y1 = 0: Y2 = 10
140 X1 = 14: X2 = 56
150 FOR K = 1 TO 9
160 FOR Y1 = Y1 TO Y1 + 15 STEP 5
170 GOSUB 500
180 X1 = X1 + 2
190 NEXT Y1
200 FOR Y2 = Y2 TO Y2 + 15 STEP 5
210 GOSUB 500
220 X2 = X2 - 2
230 NEXT Y2
240 NEXT K
250 GOSUB 500
300 REM -----------------------------------------------------------
310 REM           PRINT THE PATTERN
320 REM -----------------------------------------------------------
330 WIDTH LPRINT 255
340 LPRINT CHR$(27); "A"; CHR$(6);
350 FOR ROW = 0 TO 33
360 PLINE$ = ""
```

```
370 LPRINT CHR$(27); "K"; CHR$(101); CHR$(0);
380 FOR COL = 0 TO 100
390 PLINE$ = PLINE$ + CHR$(DOT(COL, ROW))
400 NEXT
410 LPRINT PLINE$; ""
420 NEXT
430 LPRINT CHR$(27); "2"
440 END
500 REM ------------------------------------------------
510 REM              DRAW A LINE
520 REM ------------------------------------------------
530 PRINT "line"; X1; Y1; "-"; X2; Y2
540 XLEN = X2 - X1
550 YLEN = Y2 - Y1
560 XSTEP = ABS(XLEN) + 1
570 YSTEP = ABS(YLEN) + 1
580 IF XSTEP < YSTEP THEN XSTEP = YSTEP
590 XSIZE! = XLEN / XSTEP
600 YSIZE! = YLEN / XSTEP
610 XX! = X1: YY! = Y1
620 FOR PNT = 1 TO XSTEP
630 XX! = XX! + XSIZE!
640 YY! = YY! + YSIZE!
650 GOSUB 700
660 NEXT
670 RETURN
700 REM ------------------------------------------------
710 REM            FILL THE ARRAY
720 REM ------------------------------------------------
730 YY = INT(YY! + .5)
740 XX = INT(XX! + .5)
750 ROW = INT(YY / 6)
760 BIT = YY - ROW * 6
770 DOT(XX, ROW) = DOT(XX, ROW) OR 2    (6 - BIT)
780 RETURN
```



CHAPTER 8
CREATING CHARACTERS

Even with its two fonts, near letter and draft quality, pica, elite, proportional, expanded, compressed, emphasised, doublestrike, italic, vertically enlarged print, reverse print, superscript and subscript styles, some people still can't find just the right character style on their 120D+. For these discriminating people we have just one thing to say: go ahead — design your own characters. And with the 120D+ you can!

This feature is useful not only for the artists with a discriminating eye who want to add a little flair to their printing. Instead, you could design a few unique characters for special applications such as business, scientific, or a foreign language not included in the 120D+'s international character sets.

HOW THE 120D+ PRINTS CHARACTERS

In Chapter 2, we discussed how a dot matrix printer like the 120D+ prints characters. The key is in the print head, in which the pins strike the ribbon in a predetermined pattern as it sweeps across the page. Figures 2-1 and 2-2 show a few of those patterns: for the H, y, and r.

It is no coincidence that the dots that form the characters appear to be in neat rows and columns, for that's the way they must be designed. When the 120D+'s character sets were designed, the engineers used a matrix six dots wide and nine dots high (there are nine wires in the print head, remember?). Figure 8-1 shows just such a matrix with a character design superimposed. There is a similar design for every character the 120D+ knows how to print, and the data from these patterns is stored in the printer's memory.

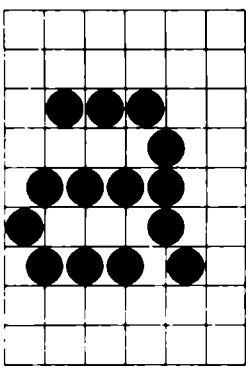
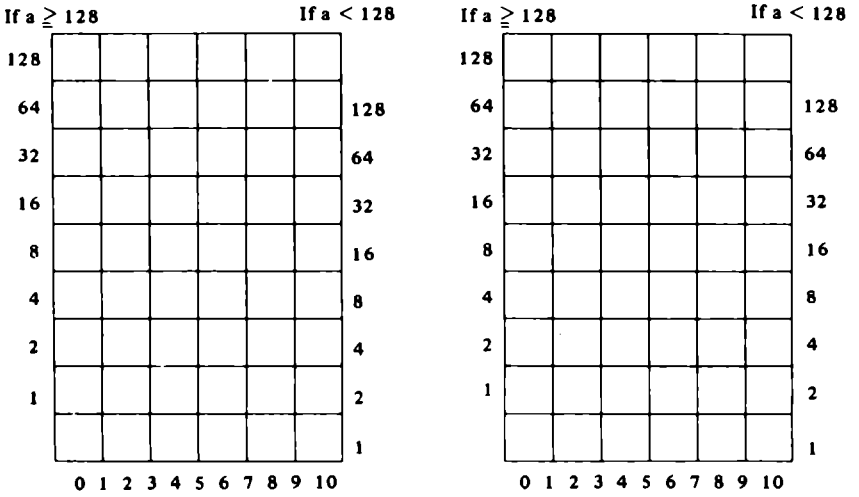


Figure 8-1. All characters are designed on a matrix like this.

DESIGNING YOUR OWN CHARACTERS

When you design characters to be printed, you'll use the same type of matrix. For your convenience, we've included a couple of blank ones in Figure 8-2. Feel free to photocopy them; they can be used to design your own characters.

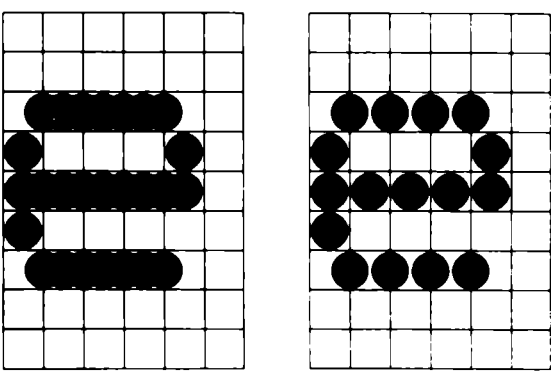
Figure 8-2.
Use these matrices to design your characters.



The first step in creating your own characters is to lay out the dots in the matrix as you want them to print. Even though the matrix is nine dots high, the characters can be only eight dots high, like the 120D+'s standard characters. (This is a limitation of the size of a data byte, which has eight bits, not of the print head itself.) Most characters use only the top seven dots, while the descenders (such as p and g) use the bottom seven pins.

And the characters you design can be eleven dots wide. How can that be done on a matrix that is six dots wide? In addition to the six dots inside the squares of the matrix, there are five intermediate columns of dots. They are centered on the lines that separate the six columns. The only limitation here is that you cannot define a character which has two immediately adjacent dots (that is, one in a box and one on the line next to it in the same row). Figure 8-3 shows the correct and incorrect ways.

Figure 8-3.
Dots cannot be printed in immediately adjacent columns.



INCORRECT CORRECT

One more consideration in designing characters: normally the last two columns (the sixth square and the line to the left of it) are left blank. This forms the space between characters. In some instances you may want the characters to touch. If so, use all eleven dot columns. And if you want to design an entire type font that just won't fit in nine columns, you can always use the proportional spacing command to add space between characters (see Chapter 4).

Copying standard characters

BASIC	CHR$(27) ":" CHR$(0) CHR$(0) CHR$(0)
Hex	1B 3A 00 00 00

Many users of user-defined characters don't define an entire alphabet; instead they define only a few special characters that they need for their specific applications. Because of the way the 120D+ stores character designs, it is easy to combine standard and user-defined characters in your print-outs.

The standard characters are all stored in the 120D+'s ROM (Read Only Memory). Each time your computer sends an ASCII code to the printer, the 120D+ prints the characters. User-defined characters are stored in a different area of the 120D+'s memory (it is called RAM, for Random Access Memory), but are accessed in the same way. You are, in effect, temporarily replacing the 120D+'s standard characters with your newly designed characters (without losing the standard characters).

In Epson Configuration when you turn the 120D+ on or reset it with the ESC @ (master reset) command, the user-defined RAM is empty: there are no character definitions. Therefore, if you want to design a few special characters to be used with the standard alphabet, you can start by copying all of either Font 1 or Font 2 draft characters from 120D+'s ROM to RAM with the ESC: CHR$(0) CHR$(0) CHR$(0) command. If you are in Font 1, then Font 1 will be copied, otherwise Font 2 will be copied. When you are in IBM mode the 120D+ will automatically copy ROM to RAM for you. You can then use both your own newly created characters with the standard draft characters.

Saving character designs in 120D+'s memory

1. Epson configuration

BASIC	CHR$(27) "&" CHR$(0) CHR$(n1) CHR$(n2) CHR$(a) CHR$(d0) . . . CHR$(d10)
Hex	1B 26 00 n1h n2h ah d0h d10h

After you have designed a character on a paper grid, the next step is to send that character definition (or group of definitions) to the 120D+ so that the characters can be printed. Doing this requires 120D+'s most complicated command (but it's really not so bad after you've tried it a few times).

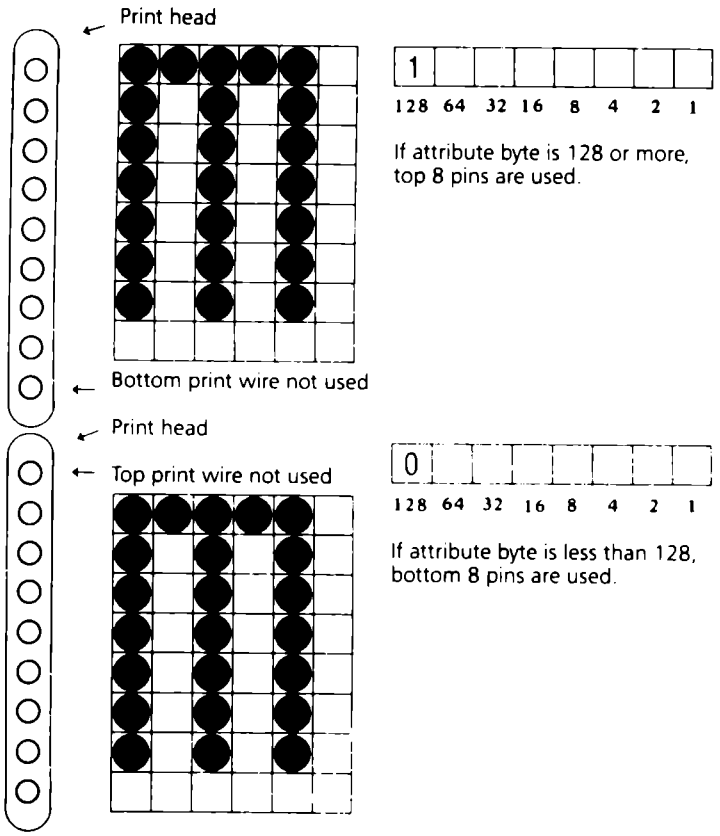
The command is ESC "&" CHR$(0) CHR$(n1) CHR$(n2) CHR$(a) CHR$(d0) . . . CHR$(d10). The first three characters, ESC "&" CHR$(0), are easy enough, but what about the rest of it?

First, n1 and n2 are variables that specify the range of characters that you wish to define with this command. As you know, each standard character has a corresponding ASCII code (these codes can be found in Appendix B). n1 and n2 are asking for the ASCII codes of the first and last character you wish to define. Any ASCII codes from 32 to 254 can be replaced. The codes that follow (CHR$ (1) CHR$ (d0) . . . CHR$(d10)0 are repeated for each character in the specified range. If you are defining ony one character, n1 and n2 are the same.

Attribute byte

The variable a is the attribute byte, for it describes some of the characteristics of the character you have defined. The first characteristic is whether the 120D+ should print your character with the top eight pins of the print head or the bottom eight pins. This is done with the high order bit of the attribute byte. If it is on (i.e. equal to one), the top eight pins are used; if it is off (zero), the bottom eight pins are used. Put another way, if the variable a has a value of 128 or more, the top pins are used; if it is less than 128, the bottom pins will be used. This is shown in Figure 8-4.

Figure 8-4.
The high order bit of an attribute determines which pins will be used.



The attritue byte also contains information that can be used if you want to print your characters with proprotional width (Chapter 4 tells how to select proportional printing). With proportional width printing some characters will be narrower than others. You must still send data (even if it is zero) for all eleven dot columns. With the attribute byte you can specify the starting and ending columns that you want to print. The columns, which are numbered from 0 through to 10, are identified at the bottom of Figure 8-5. Bits 4, 5, and 6 are used to specify the starting column. The ending column is defined by bits 0 to 3.

The entire attribute byte (which is 8 bits) consists of three parts: bit 7 determines which pins (top eight or bottom eight) will be used: bits 4, 5, and 6 specify the starting column; and bits 0, 1, 2 and 3 specify the ending column number. A sample attribute byte is shown in Figure 8-5.

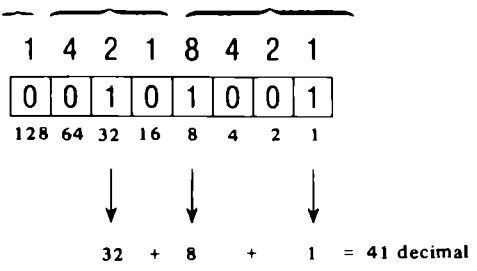


Figure 8-5.
A sample attribute byte.

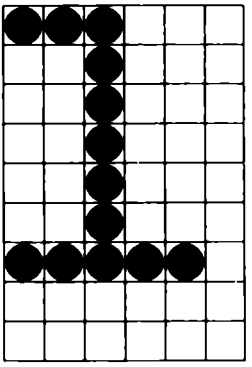
Data bytes

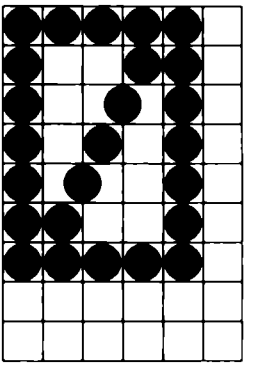
After those last three codes the rest is easy! The variables d0 through to d10 are data bytes. Their value is calculated exactly the way data bytes are calculated for dot graphics (see Chapter 7). Each pin in the print head is assigned a value. Add the values of each of the pins that you want to print in a given column, and the total for the colum is the value of that data byte.

In the sample character matrices in Figure 8-2, there are numbers on either side of the matrix. Use the numbers on the left for the dot values if you are going to use the top eight pins (attribute byte of 128 or more). If you are going to use the bottom eight pins (attribute byte less than 128), use the numbers on the right as dot values.

A sample should make all of this more easily understood. Figure 8-6 shows the stylized characters we have designed. The program that follows sends these character definitions to the 120D+ (but does not print anything — that's next).

Figure 8-6.
These characters are defined and printed in the example programs.





Example:

```
5     WIDTH LPRINT 255
10      LPRINT CHR$(27); ":"; CHR$(0); CHR$(0); CHR$(0)
15      FOR Z = 1 TO 5
20      READ N1, N2, A
30      LPRINT CHR$(27); "&"; CHR$(0); CHR$(N1); CHR$(N2); CHR$(A);
40      FOR J = 0 TO 10
50      READ D
60      LPRINT CHR$(D);
70      NEXT J, Z

100     DATA 49,49,128,130,0,130,0,254,0,2,0,2,0,0
110     DATA 50,50,128,206,0,138,0,138,0,138,0,250,0,0
120     DATA 48,48,128,254,0,134,8,146,32,194,0,254,0,0
130     DATA 68,68,128,254,0,130,0,68,0,40,0,16,0,0
140     DATA 43,43,128,16,0,16,0,254,0,16,0,16,0,0
```

This program downloads special characters for 120D+ characters. To access these characters see the example on page 106 under Printing Defined Characters.

2. IBM configuration

BASIC	CHR$(27) "=" CHR$(n1) CHR$(n2) CHR$(20) CHR$(code) CHR$(a) CHR$(0) CHR$(d0) . . . CHR$(d10)
Hex	1B 3D n1h n2h 14 codeh ah 00 d0h . . . d10h

This command sequence allows you to create your original characters in the IBM configuration as 120D+ has the same feature in the Epson configuration. But there is a difference for sending data between IBM and Epson configurations.

First, n1 and n2 are variables that specify the range of characters that you wish to define with this command. Then, calculate the total value with the following formula;

Total value = (number of characters x 13) + 2

If the total value is less than 256, then n1 = total value and n2 = 0. If the total value is greater than or equal to 256, then divide the number of bytes by 256. n1 = the remainder and n2 = the integer part of the result. For example, for 64 characters,

Total value = (64 x 13) + 2 = 834
834/256 = 3 66/256
that is, n1 = 66, n2 = 3

The code in this command is the ASCII code for the first downloaded character. Any ASCII codes from 32 to 126 can be replaced continuously from standard characters starting at that code point.

The attribute byte a shows whether the character is ascending or descending. If a = 0, the character is printed with the top eight pins of the print head (ascending character). If a = 1, the character is printed with the bottom eight pins (ascending character). Proportional spacing is not valid in the IBM configuration, so there are no values of the starting column and the ending column.

The variables d0 through to d10 are data byte. Their value is calculated exactly the way data bytes are calculated for dot graphics.

And at last, you can select the defined character with either of commands ESC I CHR$(4) or ESC I CHR$(6). Please refer to Chapter 4: printing text, Near letter quality.

PRINTING DEFINED CHARACTERS

	ON	OFF
BASIC	CHR$(27) "%1" CHR$(0)	CHR$(27) "%0" CHR$ (0)
Hex	1B 25 01 00	1B 25 00 00

Designing characters and sending their definitions to the printer is the hard part of using your own characters. Actually putting those definitions to use is as easy as selecting any of the 120D+'s other print styles; it is done with a single command.

That command is necessary because of the way the 120D+'s characters are stored. The command simply selects between the 120D+'s two banks of memory; ROM, which stores all of the standard characters (and their variations), and RAM, which stores the user-defined characters.

The command to select the user-defined character set is ESC %1 CHR$(0). To return to the standard character set, use this command: ESC %0 CHR$(0). The program below prints the same characters in each of the two character sets.

Example:

```
10        LPRINT CHR$(27); "%"; CHR$(1);
20        GOSUB 60
30        LPRINT CHR$(27); "%"; CHR$(0);
40        GOSUB 60
50        END
60        LPRINT "HERE IS THE CITIZEN 120D+"
70        LPRINT "1ST IN ITS CLASS"
80        RETURN
```

```
HERE IS THE CITIZEN 120D+
1ST IN ITS CLASS
HERE IS THE CITIZEN 120D+
1ST IN ITS CLASS
```

Special effects

Nearly all of the 120D+'s character style variations can be used with the characters you design. Just select the user-defined character set (with ESC %1 CHR$(0)) and then use the appropriate command for the desired print style.

For instance, using the master pitch command or the master print mode command you can use any of the available print widths: pica, elite, expanded, compressed, and their combinations. If you specify starting and ending print columns as part of the attribute byte of the character definition, you can print your characters in proportional width.

Some of the other special effects that can be used with user-defined characters are emphasised, doublestrike, underlining, reverse print, tall print, superscripts and subscripts.

Example:

```
10      LPRINT CHR$(27); "P"; "PICA: "; : GOSUB 130
20      LPRINT CHR$(27); "M"; CHR$(27); "^80"; "ELITE: "; : GOSUB 130
30      LPRINT CHR$(27); "P"; CHR$(15); "COMPRESSED: "; : GOSUB 130
40      LPRINT CHR$(14); "EXPANDED: "; : GOSUB 130
50      LPRINT CHR$(27); "E"; "EMPHASIZED: "; : GOSUB 130
60      LPRINT CHR$(27); "G"; "DOUBLESTRIKE: "; : GOSUB 130
70      LPRINT CHR$(27); "-1"; "UNDERLINING: "; : GOSUB 130
80      LPRINT CHR$(27); "S0"; "SUPERSCRIPT: "; : GOSUB 130
90      LPRINT CHR$(27); "S1"; "SUBSCRIPT: "; : GOSUB 130
100     LPRINT CHR$(27); "^21"; "REVERSE: "; : GOSUB 130
110     LPRINT CHR$(27); "^11"; "VERTICALLY ENLARGED: "; : GOSUB 130
120     END
130     LPRINT CHR$(27); "%"; CHR$(1); "120D+"
140     LPRINT CHR$(27); "!"; CHR$(0); CHR$(27); "T"; CHR$(27); "^10"; CHR$(27);
 "^20";
150     LPRINT CHR$(27); "F"; CHR$(27); "H"; CHR$(27); "%"; CHR$(0);
160     RETURN
```

```
PICA: 120D+
ELITE: 120D+
COMPRESSED: 120D+
EXPANDED:  120D+
EMPHASIZED: 120D+
DOUBLESTRIKE: 120D+
UNDERLINING: 120D+
SUPERSCRIPT: 120D+
SUBSCRIPT: 120D+
REVERSE: 120D+
VERTICALLY ENLARGED: 120D+
```

CHAPTER 9
ODDS AND ENDS

In this chapter we'll cover some special features and techniques that are useful with both text and graphics but don't fit into any particular category.

BUFFER COMMANDS

The 120D+ has an internal buffer, an electronic holding area, that can hold a full line of characters and codes. When you send information to the 120D+ with an LPRINT statement all of the characters and codes are actually sent to the 120D+'s buffer. They are held there until the buffer is filled or a control code such as a carriage return is received that instructs the 120D+ to empty the buffer. The accumulated information is then processed one piece at a time. Codes are interpreted and characters are printed.

Most of the time this operation is of no concern. The 120D+ just accumulates, interprets, and prints without notice. But there may be times when you would like to erase some or all of the information in the buffer before it is printed. The 120D+ has three commands that allow you to do that: delete, cancel, and master reset.

Delete

BASIC	CHR$(127)
Hex	7F

The buffer command is CHR$(127), appropriately called delete. It deletes the one text character previous to it when it is received in the buffer. For delete to work properly, it must be sent to the 120D+ before the buffer is emptied (that is, before a carriage return is sent and before a full line of characters have been sent).

Example:

```
10      WIDTH LPRINT 255
20      LPRINT CHR$(27); "!"; CHR$(72);
30      LPRINT "DELETE EATS CHARACTERS ONE BY ONE"; CHR$(127)
40      LPRINT "THE ENTIRE"; CHR$(24); "BUFFER IS CLEARED BY CANCEL"
50      LPRINT "THE ENTIRE "; CHR$(27); "@"; "BUFFER AND ALL PRINT MODES ";
60      LPRINT "ARE CLEARED BY MASTER RESET"
70      END
```

```
DELETE EATS CHARACTERS ONE BY ON
BUFFER IS CLEARED BY CANCEL
BUFFER AND ALL PRINT MODES ARE CLEARED BY MASTER RESET
```

Cancel

BASIC	CHR$(24)
Hex	18

This command, CHR$(24), is the cancel command. It cancels all information currently in the buffer when it is received. For cancel to work properly, it must be sent to the 120D+ before the buffer is emptied (that is, before a carriage return is sent and before a full line of characters have been sent).

Example:

```
5       LPRINT CHR$(27); "!"; CHR$(1); CHR$(27); "^80";
10      LPRINT "THE ENTIRE"; CHR$(24); "BUFFER IS CLEARED BY CANCEL"
20      LPRINT "THIS LINE CONTAINS MORE THAN ENOUGH TO FILL ONE LINE ON THE CITI
ZEN 120D+ AND THEREFORE THE CANCEL COMMAND ERASE THE ENTIRE LINE"; CHR$(24)

BUFFER IS CLEARED BY CANCEL
THIS LINE CONTAINS MORE THAN ENOUGH TO FILL ONE LINE ON THE CITIZEN 120D+ AND THEREFORE THE CANC
EL COMMAND ERASE THE ENTIRE LINE
```

Master reset

BASIC	CHR$(27) "@"
Hex	1B 40

The master reset command, ESC @, which we discussed in Chapter 4, cancels all information in the buffer just as the cancel command does. But, in addition, it resets all print functions to their default setting. (Except page length set via the front panel).

Example:

```
10      LPRINT CHR$(27); "!"; CHR$(237)
20      LPRINT "WITH MASTER RESET"
30      LPRINT CHR$(27); "@"; "ALL PRINT MODES"
40      LPRINT "ARE CLEARED TO DEFAULTS"
```

WITH MASTER RESET
ALL PRINT MODES
ARE CLEARED TO DEFAULTS

BACKSPACE

BASIC	CHR$(8)
Hex	8

The backspace does just what is sounds like. It moves the print head back one space enabling you to print another character over the previous one. It is a handy way to create special symbols and unusual effects.

Example:

```
10      LPRINT CHR$(27); "W1";
20      LPRINT "FUTURE PRINT";
30      FOR N = 1 TO 12: LPRINT CHR$(8); : NEXT
40      LPRINT CHR$(27); "4"; "FUTURE PRINT"
50      LPRINT CHR$(27); "@"
```

FUTURE PRINT

NOTE: In the program above, line 30 backspaces 12 times. Line 40 then changes to italics and prints the words "FUTURE PRINT" again, directly on top of the first printing.

UNIDIRECTIONAL PRINT

The 120D+ normally prints one line left to right and then prints the next line right to left. This is called *bidirectional* printing. It is the fastest way to print and it is one of the reasons the 120D+ can print at 175 characters per second.

With bidirectional print, however, the vertical alignment of characters from one line to the next is not always exact. This misalignment is very small and not noticeable in most applications. But occasionally, particularly when using block and line graphics, it becomes more obvious.

For applications where vertical alignment is more critical than speed, printing in only one direction — undirectional print — is the answer.

Continuous unidirectional print

	ON	**OFF**
BASIC	CHR$(27) "U1"	CHR$(27) "U0"
Hex	1B 55 01	1B 55 00

The command ESC U controls continuous unidirectional print. With unidirectional print, the print head prints all lines from left to right.

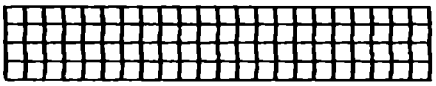
The command uses 1 and 0 as its on and off switches. Sending the 120D+ ESC "U1" turns unidirectional print on; ESC "U0" turns unidirectional print off. Since the 1 and the 0 work as on and off switches rather than actual characters, you can substitute CHR$(1) and CHR$(0) for their actual ASCII codes, if you like.

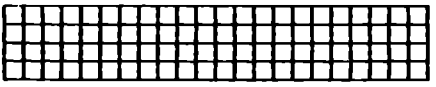
Example:

NEW

```
10      LPRINT CHR$(27); "U1";
20      GOSUB 100
30      LPRINT CHR$(27); "U0";
40      GOSUB 100
50      LPRINT CHR$(27); "@"
60      END
100     LPRINT CHR$(27); "m"; CHR$(4);
110     LPRINT CHR$(27); "1";
120     LPRINT CHR$(135);
130     FOR N = 1 TO 21: LPRINT CHR$(130); : NEXT
135     LPRINT CHR$(136)
140     FOR K = 1 TO 3
150     LPRINT CHR$(132);
160     FOR N = 1 TO 21: LPRINT CHR$(128); : NEXT
170     LPRINT CHR$(131)
175     NEXT
180     LPRINT CHR$(137);
190     FOR N = 1 TO 21: LPRINT CHR$(129); : NEXT
200     LPRINT CHR$(138)
210     LPRINT : LPRINT
220     RETURN
```

Example:





One-line unidirectional print

BASIC	CHR$(27) "<"
Hex	1B 3C

Sometimes it is necessary to print just one line unidirectional print. With this command, the print head prints one line from left to right, then returns to bidirectional print.

Example:

```
NEW
10      LPRINT CHR$(27); "m"; CHR$(4)
20      FOR N = 1 TO 3
30      FOR H = 1 TO 27: LPRINT CHR$(27); "<"; CHR$(143); : NEXT
40      LPRINT
50      NEXT
60      FOR N = 1 TO 3
70      LPRINT "BACK TO BIDIRECTIONAL PRINT"
80      NEXT
```

```
●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●
●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●
●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●
Back to bidirectional print
Back to bidirectional print
Back to bidirectional print
```

SLASHED ZERO

	ON	OFF
BASIC	CHR$(27) "~41"	CHR$(27) "~40"
Hex	1B 7E 34 01	1B 7E 34 00

In some technical printing applications, it is customary to distinguish between the letter O and the number zero by placing a slash mark through the zero. The command ESC~4 instructs the 120D+ to do that for you.

The command uses 1 and 0 as its on and off switches. Sending the 120D+ ESC~41 turns on the slashed zero feature; ESC~40 turns off the feature. Since the 1 and 0 work as on and off switches rather than actual characters, you can substitute CHR$(17) and CHR$(0) for their actual ASCII codes, if you like.

Example:

NEW

```
10        LPRINT CHR$(27); "^41"; "$1,000,000 or ";
20        LPRINT CHR$(27); "^40"; "$1,000,000"
30        LPRINT "IS A MILLION EITHER WAY"
40        END
```

```
$1,ØØØ,ØØØ OR$1,OOO,OOO
IS A MILLION EITHER WAY
```

OFF-LINE/ON-LINE

	OFF	ON
BASIC	CHR$(19)	CHR$(17)
Hex	13	11

It is sometimes desirable to turn the printer off-line within a program. The off-line command, CHR$(19) does just that. To be able to turn the 120D+ off-line from a program, send the command CHR$(19). The 120D+ ignores all further communication from the computer until it receives a CHR$(17), which turns it back on-line, restoring normal computer-to-printer communication.

NOTE: In the IBM configuration, ESC Q CHR$(3) can be used to turn the printer off-line for diagnostic purposes. Once off-line, the 120D+ will not accept data from the computer until it is either reset or turned on-line with CHR$(17) which lets the printer accept data again.

PAPER-OUT SENSOR

	ON	OFF
BASIC	CHR$(27) "9"	CHR$(27) "8"
Hex	1B 39	1B 38

The 120D+ is equipped with a sensor that detects when the paper is about to run out. As the last page of paper runs under the platen, the sensor detects the end of the page. It flashes the red Fault signal on the control panel, stops the 120D+ from printing about two inches from the bottom of the page, and turns the 120D+ off-line. If you change or add more paper and then press the control panel on-line switch, you will resume printing without losing a character.

This is a handy feature if you are using continuous paper, but can be a nuisance if you are using single sheets and want to print closer than two inches from the bottom of the page. The 120D+, therefore, provides commands to control the paper out sensor. The command ESC 8 turns off the paper-out sensor, and ESC 9 turns on the sensor.

THE EIGHTH BIT

Some computers, most notably Apple II's, send only seven bits of information to their printer instead of the more common eight bits. Since the standard ASCII character set (ASCII 0 to 127) uses only seven bits for its codes, this limitation isn't normally a problem.

But the 120D+ uses high-bit, or eight-bit, ASCII codes (ASCII 128 to 255) for block and line graphics and many other special characters. If you have a seven-bit computer, you can print these high-bit characters on the 120D+ by using the three commands described below.

Eighth bit on

BASIC	CHR$(27) ">"
Hex	1B 3E

The command ESC > instructs the 120D+ to interpret all subsequent codes as high-bit codes even if your computer is sending seven- or low-bit codes. In effect, it adds 128 to any ASCII code in the range of 0 to 127. Once your send ESC > to the 120D+, the 120D+ will continue to add 128 to any code it receives in the range of 0 to 127 until you tell it to stop with the command ESC #.

The ESC > command can be turned off with either ESC = or ESC #. The difference is that ESC # allows the 120D+ to receive all codes — whether seven-bit or eight-bit — as they are sent from your computer. ESC = forces all codes to their seven-bit value even if your computer sends eight bits.

Example:

```
10      LPRINT CHR$(27); "~50";
20      LPRINT CHR$(27); "t1";
30      FOR N = 65 TO 90: A$ = A$ + CHR$(N): NEXT
40      LPRINT A$
50      LPRINT CHR$(27); ">";
60      LPRINT A$
70      LPRINT CHR$(27); "£";
80      END
```

```
ABCDEFGHIJKLMNOPQRSTUVWXYZ
┴┬├─┼╟╢╚╔╩╦╠═╬╧╨╤╥╙╘╒╓╫╪┘┌
```

In the program above, line 10 turn on the alternative character set. Line 30 then prints A$, defined in line 20 as ASCII codes 65 to 90, the codes for capital letters. Line 40 turns on the eighth bit and line 50 then prints A$ again, this time defined as ASCII 193 to 218, the codes for graphics and special characters from the alternative character set.

Eighth bit off

BASIC	CHR$(27) "="
Hex	1B 3D

The ESC = command works the opposite of ESC >. It instructs the 120D+ to interpret all subsequent codes as low-bit codes even if the computer sends high-bit codes. In effect, it subtracts 128 from any ASCII code in the range of 128 to 255 until you tell it to stop with the command ESC #.

The ESC = command can be turned off with either ESC > or ESC #. The difference is that ESC # allows the 120D+ to receive all codes — whether seven-bit or eight-bit — as they are sent from your computer. ESC > forces all codes to their eight-bit value even if your computer sends seven bits.

Cancel eighth bit control

BASIC	CHR$(27) "#"
Hex	1B 23

The ESC # command cancels the high-bit feature selected by ESC > and ESC = and allows the 120D+ to receive both low-bit and high-bit codes again, whichever your computer sends.

Cut-Sheet Feeder

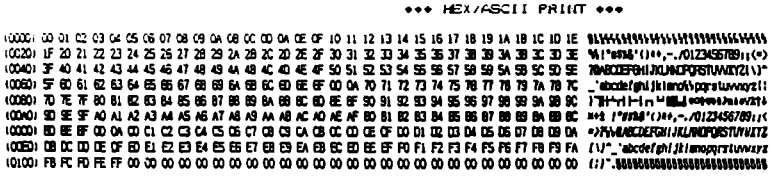
Format:	**ON**	**OFF**
BASIC	CHR$(27) CHR$(25) CHR$4	CHR$(27) CHR$(25) CHR$(0)
Hex	1B 19 04	1B 1900

Cut-sheet feeder mode is selectable via the DIP switches setting. At the same time, ESC EMn can be used to turn the 120D+ to the same status. For more details, please refer to the instruction manual of the cut-sheet feeder.

HEX/ASCII DUMP

Hex dump is not a feature that you will use for everyday printing. In this mode the 120D+ prints the hexadecimal value of every code it receives as well as the character, or the control code, each value stands for. And the 120D+ goes one step further by actually printing the abbreviation of each control code. Most printers show only a period for these "hard-to-remember" control codes. Hex dump is a very powerful program debugging feature. When your program doesn't print what it's supposed to, hex dump shows you the exact codes the 120D+ is receiving. The codes the 120D+ receives may or may not be what you intended, depending on what translations your BASIC and your computer interface make. Hex dump mode is turned on by holding down both the FF and LF switches on the control panel while you turn on power to the 120D+. To see what translations, if any, your computer makes to the ASCII codes, turn on hex dump mode and run the following program. (Line 40 is necessary to clear the buffer so that the last line of codes prints.)

Example:



You will see your computer's interpretation of the hexdecimal ASCII values from 00 to FF printed 20 per line with the corresponding characters and control character names printed to the right.

Here's another example. This print-out is a hex dump of the program used in Chapter 4 to select proportional printing. (Remember to press the On-line switch to clear the buffer and print the last line.).

CHAPTER 10

SERIAL INTERFACE

INTRODUCTION

The optional serial BIP (Basic Interface Pack) RS-232C delivers serial data from a host computer into the Citizen 120D+ printer.

The Citizen 120D+ contains a set of switches inside the interface cartridge that allows you to control the way the printer behaves. These internal switches determine the default condition for several of the 120D+'s features.

Changing the Interface Cartridge

The interface cartridge has been uniquely designed for two purposes: for simple installation of the optional interface, and for quickly changing the internal switches.

WARNING:
Never remove the interface cartridge when the power is on. Doing so may damage the printer and/or your computer.

SPECIFICATIONS

SPECIFICATIONS:

I/F Type:	RS-232C
Synchronization:	Asynchronous
Baud Rate:	110, 300, 600, 1200, 2400, 4800, 9600 (bits/sec.)
Word Length:	7 or 8 data bits (selectable) 1 start bit parity — odd, even or none (selectable)
Protocol:	DATA busy (one byte) DTR busy X-ON/X-OFF

Pin Assignment

Marked ● : Required signal
◆ : Signal not always required
X : Not required

Pin No.	Signal	IN/OUT	DATA BUSY	DTR BUSY	X-ON/ X-OFF
1	FG	—	●	●	●
2	TXD	OUT	X	X	●
3	RXD	IN	●	●	●
4	RTS	OUT	◆	◆	◆
5	—	IN	X	X	X
6	DSR	IN	X	X	X
7	SG	—	●	●	●
8	—	IN	X	X	X
11	*DB	OUT	●	X	X
20	DTR	OUT	◆	●	◆
22	—	—	X	X	X
25	+5V	OUT	X	X	X
15	—	—	X	X	X
17	—	—	X	X	X
24	—	—	X	X	X

The column heading "IN/OUT" refers to the direction of signal flow as viewed from the printer.

Description on interface signals

- TXD (Transmit Data or Send Data): Signal line to transfer data from the printer to the host.
- RXD (Receive Data): Signal line to transfer data from the host to the printer.
- RTS (Request To Send): Indicates that data from the host can be received. This signal line is in HIGH level for ON LINE status.
- *DB (Data Busy): A BUSY signal given character by character. Can be received when this is in HIGH level.
- DTR (Data Terminal Ready): Goes to HIGH level when the printer can send or receive data. In DTR busy protocol, this goes to HIGH level when the data can be received.
- +5V Power supply of +5V for maintenance. Do not use this line by the user. If used, the printer may be damaged.

Data transfer protocol

1. DATA busy: (One byte)
Busy control by character is done by using *DB (11 PIN). This goes to HIGH level when the data can be received and goes to LOW level when the data is sent form the host. As the printer takes in the data, it goes to HIGH level again.

2. DTR busy:
Busy control is done by using DTR signal (20 PIN).
DTR will go to LOW Level if the remaining capacity of the buffer gets less than 256 bytes.
DTR will go to HIGH level if the data in the buffer gets less than 256 bytes.

3. X-ON/X-OFF:
X-OFF code (CHR$(19)) is sent to the host when the remaining capacity of the buffer gets less than 256 bytes.
X-ON code (CHR$(17)) is sent to the host when the number of data in the buffer gets less than 256 bytes.

Switch Settings

The internal switch is actually two sets of eight switches, both them are labelled 1 through 8. Basically, one set of swtiches labelled SW1 designates the 120D+ as either an Epson FX/LX printer or an IBM Graphics printer, and the other set of switches labelled SW2 designates the specifications for serial data transfer.

Switches SW1-1,8
The selection of either Epson or IBM configurations and of the various combinations of printer features that can be set is explained in Appendix D as the operation of switch 1 on the serial interface pack is identical to the only switch available on the parallel interface pack.

SWITCHES SW2

SW No.	Function	ON	OFF
SW2-1	Baud rate setting		
SW2-2	(Refer to		
SW2-3	another table)		
SW2-4	Protocol	X-ON/X-OFF	DTR busy DATA busy
SW2-5	Data bit	7	8
SW2-6	Parity bit	YES	NONE
SW2-7	Parity ODD/EVEN	ODD	EVEN
SW2-8	—	—	—

BAUD RATE SETTING

SW2-1	SW2-2	SW2-3	Baud rate (bits/sec.)
OFF	OFF	OFF	9600
ON	OFF	OFF	4800
OFF	ON	OFF	2400
ON	ON	OFF	1200
OFF	OFF	ON	600
ON	OFF	ON	300
OFF	ON	ON	110

Recommended Connecting Circuit

Line Driver

(75188 or equivalent circuit)
Line Receiver

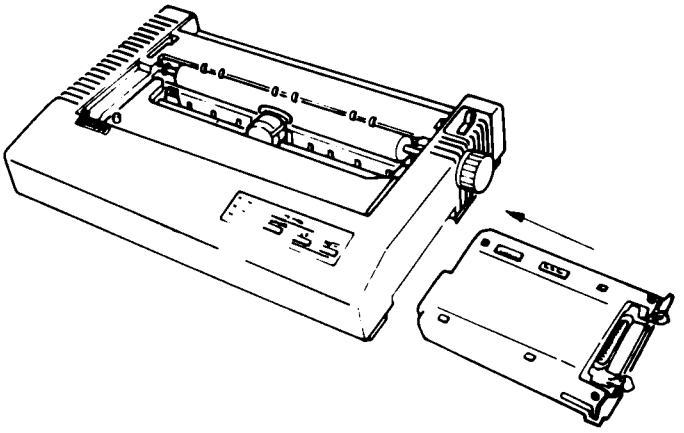
(75189 or equivalent circuit)

Serial Interface Board

Installation

The interface cartridge has been uniquely designed for two purposes: for simple installation of the optional interface, and for quickly changing the internal switches.

WARNING: Never remove the interface cartridge when the power is on. Doing so may damage the printer and/or your computer.



The interface cartridge is located on the right side of the printer. To change the interface cartridge, first disconnect the power from the printer and then remove the interface cable. Then grasp the bottom edge of the cartridge and slide the cartridge out.

After setting the switches, simply slide the cartridge back into the slot. Be careful not to slam the cartridge or force it in any way. Slide the cartridge in until you feel the connector touch the plug inside. Then gently, but firmly, push the cartridge in the rest of the way to secure the connection. Connect the proper interface cable and you're ready to go!

APPENDIX A
MAINTENANCE

The Citizen 120D+ printer requires very little routine maintenance. In fact, the best maintenance for your 120D+ printer is preventive. If you follow the suggestions in Chapter 1 for locating the 120D+ in an area free of excessive dust and heat when you set up your printer, your 120D+ will give you long and trouble-free performance.

Periodic cleaning, replacement of the ribbon, and, after a very long time, replacement of the print head are about the only maintenance tasks you will encounter. We'll cover these items in this chapter.

WARNING: Always turn the power off, unplug the power cord and disconnect the printer cable when performing any type of maintenance.

CLEANING

Dirt and dust are the 120D+'s biggest enemies. The printer cover will keep most dirt from the printer mechanism, but an occasional cleaning to remove paper particles is a good idea.

If you're just giving the 120D+ a general cleaning, you don't have to remove the upper case. First, turn the power off and disconnect the power cord. Then just remove the printer cover and the ribbon cartridge and clean the areas you can easily reach, following the cleaning suggestions in this section. When you have finished, replace the ribbon cartridge and printer cover and reconnect the power cord.

To clean the inside of the printer completely, we recommend that the printer is returned to a Citizen authorised service agency.

Please note that any unauthorised dismantling of the printer other than as previously defined for cleaning or dipswitch setting will invalidate the Citizen warranty.

To clean the inside of the printer, use a soft brush to whisk lint and dust away from the print head area, being careful not to damage any of the cables and pulleys. Do not dust the interface pack circuit board area.

The outside of the printer case can be cleaned when needed with a damp rag and alcohol.

RIBBON CARTRIDGE

The inked ribbon in the cartridge is a continuous loop and will print about two million characters before needing replacement. When printed characters begin to appear faint, it is a sign to replace the ribbon cartridge.

Replacing the ribbon is a simple matter of snapping out the old cartridge and replacing it with a new one. Before removing the old cartridge, however, always turn off the power and slide the print head to the left edge to avoid damage to the print head cable. See the ribbon installation section in Chapter 1 for details.

THE PRINT HEAD

The print head has a very long life, printing as many as 100 million characters before it shows any signs of wear. You will know that it needs replacement when printed characters are faint even with a new ribbon cartridge.

The 120D+ is designed so that you do not have to get inside the printer to change the print head. Follow these simple steps to replace the print head:

1. Turn the power off and disconnect the power cable.
2. Remove the printer cover and the ribbon cartridge.
3. Locate the print head to the most left position and its connection as shown in Figure A-2. Grasp the cable and the plastic reinforcer that covers it and gently pull the cable free from the connector.

4. Unlock the print head by moving the locking lever to the right. Then pulling up on the print head, remove it from the head guide.
5. Place the new print head into position in the head guide and press down until it snaps securely in place.
6. Bring the cable around in front of the pulley and insert it into the connector as shown in Figure A-3.

When you have finished, replace the ribbon cartridge and printer cover. You're ready to start printing again.

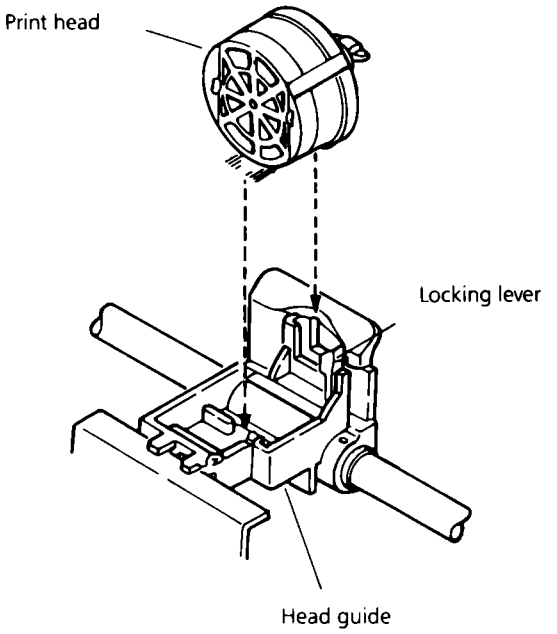


Figure A-2.
Replacing the print head.

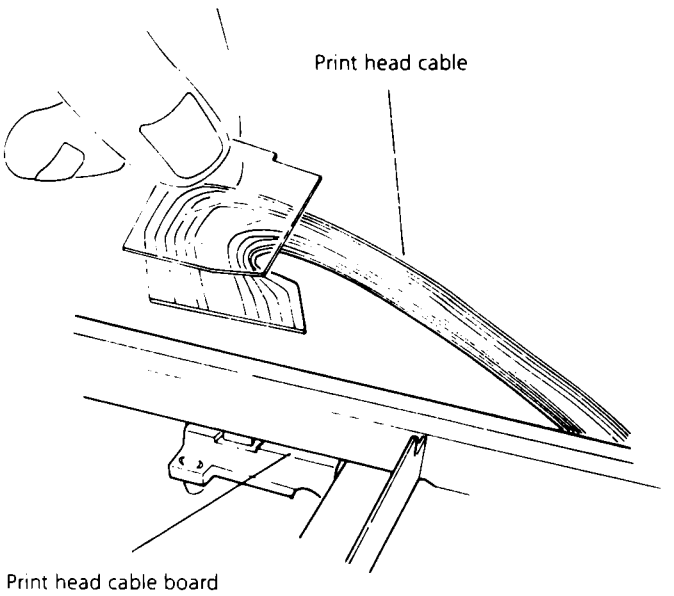


Figure A-3.
Reconnecting the print head cable

APPENDIX B

THE 120D + CHARACTER SET

Codes marked with an asterisk are used for international characters. The characters assigned to these codes change according to the international character set selected: the characters shown are standard ASCII, the "international character set" for the U.S.A.

ASCII codes		Control	Epson FX/LX configuration		IBM Graphics configuration			
Decimal	Hexadecimal	keys	Standard	Graphics	Set 1	Set 2	All char.	
0	00	CTRL @						
1	01	CTRL A						
2	02	CTRL B						
3	03	CTRL C						
4	04	CTRL D						
5	05	CTRL E						
6	06	CTRL F						
7	07	CTRL G						
8	08	CTRL H	BS		BS			
9	09	CTRL I	HT		HT			
10	0A	CTRL J	LF		LF			
11	0B	CTRL K	VT		VT			
12	0C	CTRL L	FF		FF			
13	0D	CTRL M	CR		CR			
14	0E	CTRL N	SO		SO			
15	0F	CTRL O	SI		SI			
16	10	CTRL P						
17	11	CTRL Q	DC1		DC1			
18	12	CTRL R	DC2		DC2			
19	13	CTRL S	DC3		DC3			
20	14	CTRL T	DC4		DC4			
21	15	CTRL U						
22	16	CTRL V						
23	17	CTRL W						
24	18	CTRL X	CAN		CAN			
25	19	CTRL Y						
26	1A	CTRL Z						
27	1B	CTRL [	ESC		ESC			
28	1C							
29	1D							
30	1E							
31	1F							
32	20		SPACE	SPACE	SPACE	SPACE	SPACE	
33	21							
34	22							
35	23							*
36	24							*
37	25							
38	26							
39	27							
40	28							
41	29							
42	2A							
43	2B							
44	2C							
45	2D							

ASCII codes Decimal	Hexadecimal	Control keys	Epson FX/LX configuration Standard	Graphics	IBM Graphics configuration Set 1	Set 2	All char.	
46	2E		.	.	.	.	.	
47	2F		/	/	/	/	/	
48	30		0	0	0	0	0	
49	31		1	1	1	1	1	
50	32		2	2	2	2	2	
51	33		3	3	3	3	3	
52	34		4	4	4	4	4	
53	35		5	5	5	5	5	
54	36		6	6	6	6	6	
55	37		7	7	7	7	7	
56	38		8	8	8	8	8	
57	39		9	9	9	9	9	
58	3A		:	:	:	:	:	
59	3B		;	;	;	;	;	
60	3C		<	<	<	<	<	
61	3D		=	=	=	=	=	
62	3E		>	>	>	>	>	
63	3F		?	?	?	?	?	
64	40		@	@	@	@	@	*
65	41		A	A	A	A	A	
66	42		B	B	B	B	B	
67	43		C	C	C	C	C	
68	44		D	D	D	D	D	
69	45		E	E	E	E	E	
70	46		F	F	F	F	F	
71	47		G	G	G	G	G	
72	48		H	H	H	H	H	
73	49		I	I	I	I	I	
74	4A		J	J	J	J	J	
75	4B		K	K	K	K	K	
76	4C		L	L	L	L	L	
77	4D		M	M	M	M	M	
78	4E		N	N	N	N	N	
79	4F		O	O	O	O	O	
80	50		P	P	P	P	P	
81	51		Q	Q	Q	Q	Q	
82	52		R	R	R	R	R	
83	53		S	S	S	S	S	
84	54		T	T	T	T	T	
85	55		U	U	U	U	U	
86	56		V	V	V	V	V	
87	57		W	W	W	W	W	
88	58		X	X	X	X	X	
89	59		Y	Y	Y	Y	Y	
90	5A		Z	Z	Z	Z	Z	
91	5B		[	[	[	[	[	*
92	5C		\	\	\	\	\	*
93	5D		]	]	]	]	]	*

* These characters may be different if you are using an international character set other than the USA set. The characters for each set are shown in Table 4-6.

ASCII codes Decimal	Hexadecimal	Control keys	Epson FX/LX configuration Standard	Graphics	IBM graphics configuration Set 1	Set 2	All char.	
94	5E		^	^	^	^	^	*
95	5F		_	_	_	_	_	
96	60		`	`	`	`	`	*
97	61		a	a	a	a	a	
98	62		b	b	b	b	b	
99	63		c	c	c	c	c	
100	64		d	d	d	d	d	
101	65		e	e	e	e	e	
102	66		f	f	f	f	f	
103	67		g	g	g	g	g	
104	68		h	h	h	h	h	
105	69		i	i	i	i	i	
106	6A		j	j	j	j	j	
107	6B		k	k	k	k	k	
108	6C		l	l	l	l	l	
109	6D		m	m	m	m	m	
110	6E		n	n	n	n	n	
111	6F		o	o	o	o	o	
112	70		p	p	p	p	p	
113	71		q	q	q	q	q	
114	72		r	r	r	r	r	
115	73		s	s	s	s	s	
116	74		t	t	t	t	t	
117	75		u	u	u	u	u	
118	76		v	v	v	v	v	
119	77		w	w	w	w	w	
120	78		x	x	x	x	x	
121	79		y	y	y	y	y	
122	7A		z	z	z	z	z	
123	7B		{	{	{	{	{	*
124	7C		|	|	|	|	|	*
125	7D		}	}	}	}	}	*
126	7E		~	~	~	~	~	*
127	7F		DEL		DEL			
128	80			┼		Ç	Ç	
129	81			┴		ü	ü	
130	82			┬		é	é	
131	83			┤		â	â	
132	84			├		ä	ä	
133	85			─		à	à	
134	86			┼		å	å	
135	87			┌		ç	ç	
136	88		BS	┐	BS	ê	ê	
137	89		HT	└	HT	ë	ë	
138	8A		LF	┘	LF	è	è	
139	8B		VT	▒	VT	ï	ï	
140	8C		FF	■	FF	î	î	

* These characters may be different if you are using an international character set other than the USA set. The characters for each set are shown in Table 4-6.

ASCII codes Decimal	Hexadecimal	Control keys	Epson FX/LX configuration Standard	Graphics	IBM Graphics configuration Set 1	Set 2	All char.
141	8D		CR		CR		
142	8E		SO		SO		
143	8F		SI		SI		
144	90						
145	91		DC1		DC1		
146	92		DC2		DC2		
147	93		DC3		DC3		
148	94		DC4		DC4		
149	95						
150	96						
151	97						
152	98		CAN		CAN		
153	99						
154	9A						
155	9B		ESC		ESC		
156	9C						
157	9D						
158	9E						
159	9F						
160	A0		SPACE				
161	A1		!	!			
162	A2		"	"			
163	A3		#	#			
164	A4		$	$			
165	A5		%	%			
166	A6		&	&			
167	A7		'	'			
168	A8		(	(			
169	A9		)	)			
170	AA		*	*			
171	AB		+	+	½	½	½
172	AC		,	,	¼	¼	¼
173	AD		-	-	¡	¡	¡
174	AE		.	.		«	«
175	AF		/	/		»	»
176	B0		0	0			
177	B1		1	1			
178	B2		2	2			
179	B3		3	3			
180	B4		4	4			
181	B5		5	5			
182	B6		6	6			
183	B7		7	7			
184	B8		8	8			
185	B9		9	9			
186	BA		:	:			
187	BB		;	;			
188	BC		<	<			
189	BD		=	=	¢	¢	¢

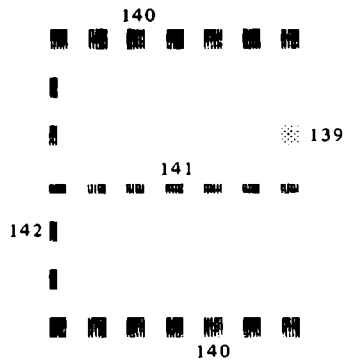
* These characters may be different if you are using an international character set other than the USA set. The characters for each set are shown in Table 4-6.

ASCII codes Decimal	Hexadecimal	Control keys	Epson FX/LX configuration Standard	Graphics	IBM graphics configuration Set 1	Set 2	All char.
190	BE						
191	BF						
192	C0						
193	C1						
194	C2						
195	C3						
196	C4						
197	C5						
198	C6						
199	C7						
200	C8						
201	C9						
202	CA						
203	CB						
204	CC						
205	CD						
206	CE						
207	CF						
208	D0						
209	D1						
210	D2						
211	D3						
212	D4						
213	D5						
214	D6						
215	D7						
216	D8						
217	D9						
218	DA						
219	DB						
220	DC						
221	DD						
222	DE						
223	DF						
224	E0				α	α	α
225	E1		a	a	ß	ß	ß
226	E2		b	b	Γ	Γ	Γ
227	E3		c	c	π	π	π
228	E4		d	d	Σ	Σ	Σ
229	E5		e	e	σ	σ	σ
230	E6		f	f	µ	µ	µ
231	E7		g	g	τ	τ	τ
232	E8		h	h	Φ	Φ	Φ
233	E9		i	i	Θ	Θ	Θ
234	EA		j	j	Ω	Ω	Ω
235	EB		k	k	δ	δ	δ
236	EC		l	l	∞	∞	∞
237	ED		m	m	ø	ø	ø

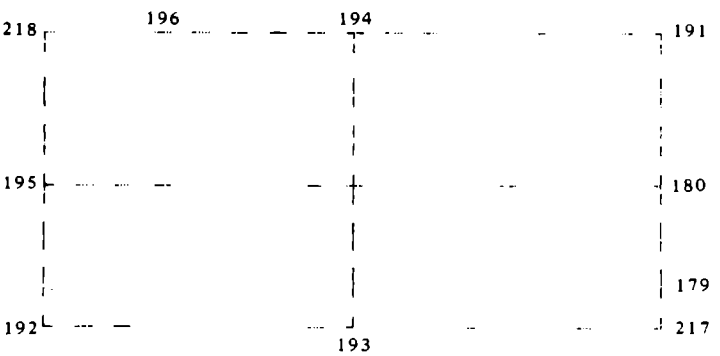
* These characters may be different if you are using an international character set other than the USA set. The characters for each set are shown in Table 4-6.

ASCII codes Decimal	Hexadecimal	Control keys	Epson FX/LX configuration Standard	Graphics	IBM Graphics configuration Set 1	Set 2	All char.
238	EE		n	n	∈	∈	∈
239	EF		o	o	∩	∩	∩
240	F0		p	p	≡	≡	≡
241	F1		q	q	±	±	±
242	F2		r	r	≥	≥	≥
243	F3		s	s	≤	≤	≤
244	F4		t	t	⌠	⌠	⌠
245	F5		u	u	⌡	⌡	⌡
246	F6		v	v	÷	÷	÷
247	F7		w	w	≈	≈	≈
248	F8		x	x	°	°	°
249	F9		y	y	∙	∙	∙
250	FA		z	z	·	·	·
251	FB		{	{	√	√	√
252	FC		|	|	ⁿ	ⁿ	ⁿ
253	FD		}	}	²	²	²
254	FE		~	~	■	■	■
255	FF				SPACE	SPACE	SPACE

Epson FX/LX configuration:



IBM Graphics Printer configuration:



APPENDIX C

COMMANDS IN NUMERICAL ORDER

CTRL-H or CHR$(8)	Backspace
CTRL-I or CHR$(9)	Horizontal tab (htab)
CTRL-J or CHR$(10)	Line Feed
CTRL-K or CHR$(11)	Vertical tab (vtab)
CTRL-L or CHR$(12)	Form Feed
CTRL-M or CHR$(13)	Carriage return
CTRL-N or CHR$(14)	Sets one-line expanded print
CTRL-O or CHR$(15)	Sets compressed print
CTRL-Q or CHR$(17)	Sets printer selected
CTRL-R or CHR$(18)	Cancels compressed print
CTRL-S or CHR$(19)	Sets printer deselected (Epson only)
CTRL-T or CHR$(20)	Cancels one-line expanded print
CTRL-X or CHR$(24)	Cancel line
ESC CTRL-N or ESC CHR$(14)	Sets one-line expanded print
ESC CTRL-O or ESC CHR$(15)	Sets compressed print
ESC CTRL-Y n or ESC CHR$(25) n	(n = 1 ON, n = 0 OFF) Enables/disables optional cut sheet feeder
ESC (space) n	Increases proportional spacing by n dots
ESC ! CHR$(n)	Selects print mode number n
ESC #	Cancels high-bit/low-bit code conversion
ESC $ CHR$(n1) CHR$(n2)	Absolute dot tab
ESC %n CHR$(0)	(n = 1 ON, n = 0 OFF) Selects/cancels defined characters
ESC & CHR$(0) CHR$(n1) CHR$(n2) CHR$(a) CHR$(d0) . . . CHR$(d10)	Define characters
ESC * CHR$(m) CHR$(n1) CHR$(n2)	Sets graphics mode m
ESC −n(n = 1 ON, n = 0 OFF)	Sets/cancels underlined print
ESC / CHR$(n)	Sets vtabs in channel n as current values (Epson only)
ESC 0	Sets 1/8 inch line spacing
ESC 1	Sets 7/72 inch line spacing
ESC 2	Sets 1/6 inch line spacing (Epson only)
	Sets line spacing defined by ESC A or defaults to 1/6 inch (IBM only)
ESC 3 CHR$(n)	Sets n/216 inch line spacing
ESC 4	Sets italic characters (Epson only)
	Sets top-of-form at current paper position (IBM only)
ESC 5	Cancels italic characters (Epson only)
ESC 5n (n = 1 ON, n = 0 OFF)	Enables/disables auto line feed (IBM only)
ESC 6	Sets accented characters (IBM only)
	Sets expanded printable area (Epson only)
ESC 7	Cancels accented characters (IBM only)
	Cancels expanded printable area (Epson only)
ESC 8	Disables paper-out sensor
ESC 9	Enables paper-out sensor
ESC : CHR$(0) CHR$(0) CHR$(0)	Copy ROM to RAM characters (Epson only)
ESC :	Selects elite pitch (IBM only)

ESC <	Sets one-line unidirectional print
ESC =	Sets low-bit (Epson only) Defines characters (IBM only)
ESC >	Sets high-bit
ESC ? n CHR$(m)	Changes from graphics mode n to m
ESC @	Resets printer to power-on default settings and clears buffer
ESC A CHR$(n)	Sets n/72 inch line spacing
ESC B CHR$(n1) CHR$(n2) . . . CHR$(0)	Sets variable vtabs at lines n1, n2 . . .
ESC C CHR$(n)	Sets page length to n lines
ESC C CHR$(0) CHR$(n)	Sets page length to n inches
ESC D CHR$(n1) CHR$(n2) . . . CHR$(0)	Sets variable htabs at columns n1, n2 . . .
ESC E	Sets emphasised print
ESC F	Cancels emphasised print
ESC G	Sets doublestrike print Sets correspondence quality (IBM only)
ESC H	Cancels doublestrike print
ESC In	Selects download characters in draft (n = 4) print. Selects standard character set in draft (n = 0) or correspondence quality (n = 2) print (IBM only)
ESC I	Selects/cancels printable area expansion (Epson only)
ESC J CHR$(n)	One-time line feed of n/216 inches
ESC k*n*	Sets character font style
ESC K CHR$(n1) CHR$(n2)	Sets single density graphics
ESC L CHR$(n1) CHR$(n2)	Sets low-speed double density graphics
ESC M	Selects high-speed elite mode.
ESC N CHR$(n)	Sets bottom margin at n lines
ESC O	Cancels bottom margin
ESC P	Selects pica pitch
ESC Q CHR$(n)	Sets right margin at column n (Epson only)
ESC Q CHR$(3)	Turns printer deselected for diagnostic purposes (IBM only)
ESC R CHR$(n)	Selects accented (international) character set n (Epson only)
ESC R	Clears all htabs and vtabs (IBM only)
ESC SO	Sets superscript characters
ESC S1	Sets subscript characters
ESC T	Cancels super/subscript characters
ESC Un (n = 1 ON, n = 0 OFF)	Sets/cancels unidirectional print

ESC Wn (n = 1 ON, n = 0 OFF)	Sets continuous expanded print
ESC Y CHR$(n1) CHR$(n2)	Sets double density graphics
ESC Z CHR$(n1) CHR$(n2)	Sets quadruple density graphics
ESC \ CHR$(n1) CHR$(n2)	Relative dot tab (Epson only)
	Prints continuously from all characters chart (IBM only)
ESC ^ CHR$(m) CHR$(n1) CHR$(n2)	Sets nine-pin graphics in single density (m = 0) or double density (m = 1) (Epson only)
ESC ^ CHR$(n)	Prints a single character from all characters chart (IBM only)
ESC _n (n = 1 ON, n = 0 OFF)	Sets/cancels overscoring (IBM only)
ESC a CHR$(n)	In correspondence quality, justifies text flush left (n = 0), centred (n = 1), flush right (n = 2), or fully justified (n = 3) (Epson only)
ESC b CHR$(N) CHR$(n1) CHR$(n2) . . . CHR$(0)	Sets vtabs n1, n2, . . . in channel N
ESC e CHR$(0) CHR$(n)	Sets htabs every n columns
ESC e CHR$(1) CHR$(n)	Sets vtabs every n lines
ESC f CHR$(0) CHR$(n)	Moves print head n columns to the right
ESC f CHR$(1) CHR$(n)	Advances the paper n lines
ESC h	Sets vertically enlarged print
ESC l CHR$(n)	Sets left margin at column n
ESC m CHR$(n) (n = 4 ON, n = 0 OFF)	Sets/cancels Epson only FX line and block graphics characters or IBM only accented characters
ESC pn (n = 1 ON, n = 0 OFF)	Sets/cancels proportional printing
ESC tn	Selects IBM or Epson Top Set characters or graphics (Epson mode only)
ESC u	Cancels vertically enlarged print
ESC xn (n = 1 ON, n = 0 OFF)	Sets correspondence quality mode
ESC ~0 CHR$(n)	Sets n/144 inch line spacing
ESC ~1n (n = 0 to 6)	Selects/cancels vertically and horizontally enlarged print
ESC ~2n (n = 1 ON, n = 0 OFF)	Sets/cancels reverse print
ESC ~3 CHR$(n)	Selects pica or elite, in normal or compressed pitch
ESC ~4n (n = 1 ON, n = 0 OFF)	Sets/cancels slashed zero feature
ESC ~5n	Sets Epson only FX (n = 0) or IBM Graphics Printer (n = 1) configuration
ESC ~8n	Selects High-speed/Normal elite mode.
DEL or CHR$(127)	Deletes last character

APPENDIX D

THE INTERNAL SWITCHES

The Citizen 120D+ contains a set of switches inside the parallel interface cartridge that allows you to control the way the printer behaves. These internal switches determine the default condition for several of the 120D+'s features.

Most of the features that are controlled by the switches can also be changed with BASIC commands regardless of how the switches are set.

REMOVING THE INTERFACE CARTRIDGE

The parallel interface cartridge has been uniquely designed for two purposes: for simple installation of the optional serial interface, and for quickly changing the internal switches.

WARNING: Never remove the interface cartridge when the power is on. Doing so may damage the printer and/or your computer.

The interface cartridge is located on the right side of the printer (Figure D-1). To access the internal switches, first disconnect the interface cable. Then grasp the bottom edge of the cartridge and slide the cartridge out.

After changing the switches, simply slide the cartridge back into the slot. Be careful not to slam the cartridge or force it in any way. Slide the cartridge in until you feel the connector touch the plug inside. Then gently, but firmly, push the cartridge in the rest of the way to secure the connection. Reconnect the interface cable and you are ready to go!

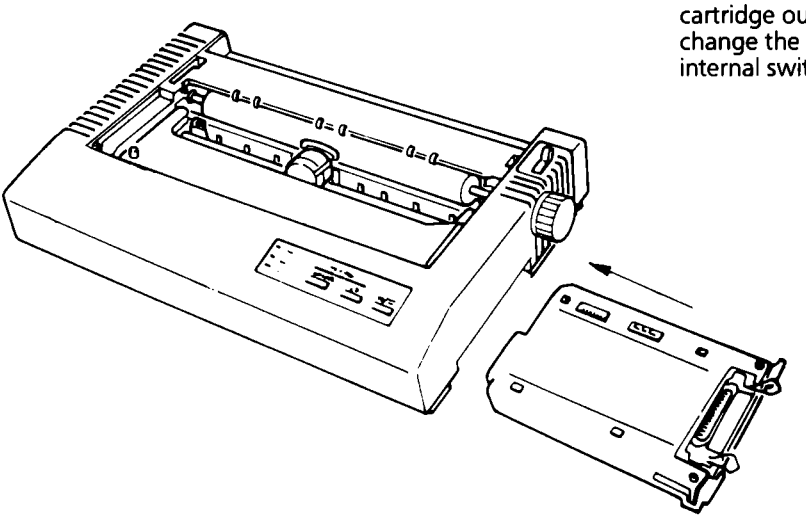


Figure D-1. Slide the interface cartridge out to change the internal switches.

SWITCH SETTINGS

The internal switch (Figure D-2) is actually a set of eight switches, labelled 1 through to 8. Each switch consists of a small lever. As you hold the cartridge as shown in Figure D-2, moving the lever down turns the switch off; moving it up turns the switch on.

Basically, these switches configure the 120D+ as either an Epson FX/LX printer or an IBM Graphics Printer. Switches 1 and 2 remain the same with both configurations. Switches 3 and 4 select three different Epson configurations (described as Epson) and the IBM configuration. Switches 5 through to 8 perform different functions in each configuration.

Table D-1 shows the functions for switches 1 through to 3. Tables D-2 through to D-5 show switch functions by configuration.

Figure D-2. The internal switches.

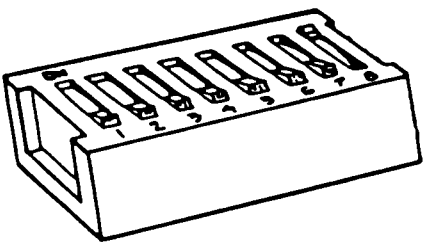
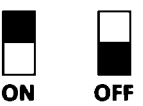
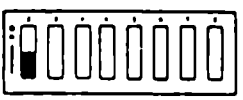
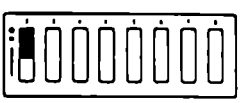


TABLE D-1. SETTINGS FOR SWITCHES 1 THROUGH 3

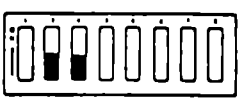


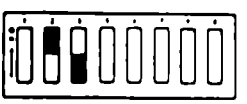
Automatic line feed:

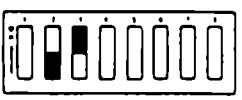
OFF 

ON 

Printer configuration:

Epson 1 (see Table D-2) 

Epson 2 (see Table D-3) 

IBM 1 (see Table D-4) 

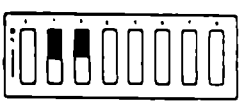
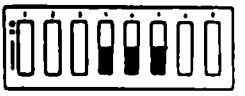
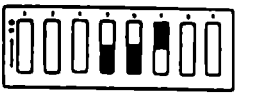
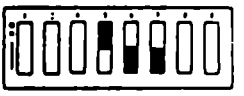
IBM 2 - Graphics Printer (see Table D-5) 

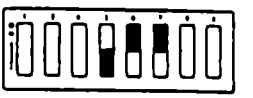
TABLE D-2. EPSON 1 CONFIGURATION (SWITCH 2 AND 3 OFF)

International characters:

U.K. 

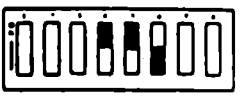
Denmark 

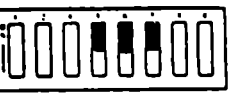
France 

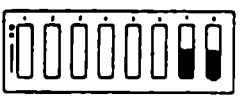
Sweden 

Germany 

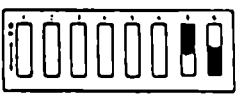
Italy 

U.S.A. 

Spain 

Form length: 11 inches 

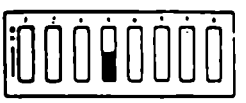
8 inches 

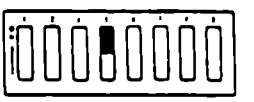
Form length: 12 inches 

A.S.F. 

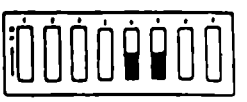
TABLE D-3 EPSON 2 CONFIGURATION (SWITCH 2 ON, 3 OFF)

Interpret ASCII codes 128 to 159 as:

High-bit control codes 

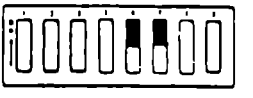
Line and block graphics 

International characters:

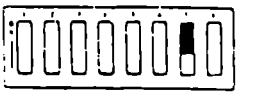
U.K. 

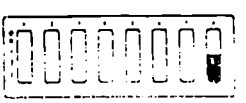
Germany 

France 

U.S.A. 

Character pitch: Pica (10 char. per inch) 

Condensed (17 char. per inch) 

Character Font 1 Courier 

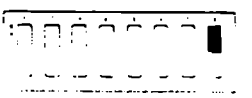
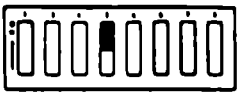
Character Font 2 Citizen Display 

TABLE D-4. IBM 1 CONFIGURATION (SWITCH 2 OFF, SWITCH 3 ON)

Interpret ASCII codes
128 to 159 as:

High-bit control codes

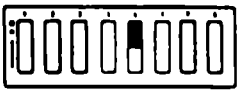
Accented characters



Line spacing:

1/6 inch

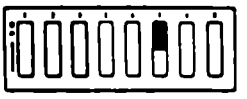
1/8 inch



Automatic carriage return:

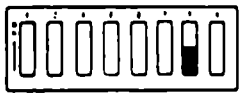
Enabled

Disabled



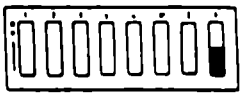
Forms length:

11 inches



12 inches

Character Font 1 Courier



Character Font 2 Citizen Display

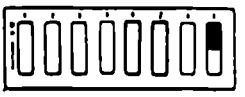
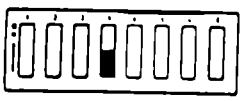


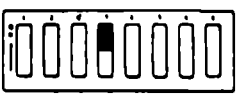
TABLE D-5. IBM 2 CONFIGURATION (SWITCH 2 AND 3 ON)

Interpret ASCII codes
128 to 159 as:

High-bit control codes

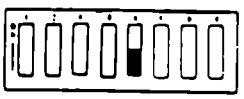


Accented characters

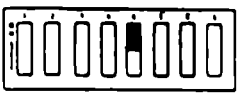


Slashed zero:

OFF



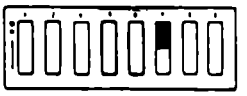
ON



Scandinavian characters:

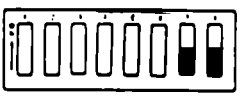
OFF

ON

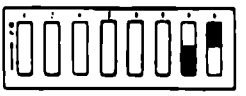


Forms length:

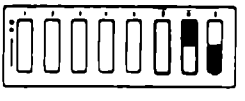
11 inches



8 inches



12 inches



A.S.F.

SWITCH FUNCTIONS

Switch 1.
Switch 1 determines whether the 120D+ adds a line feed to each carriage return. With switch 1 OFF the computer must send a line feed with every carriage return (the most common situation). With switch 1 ON the 120D+ adds a line feed to each carriage return it receives.

Switches 2 and 3.
These two switches select between either the Epson-FX/LX configuration or the IBM Graphics configuration. There are two possible Epson configurations which make switches 4 through to 8 act differently. The switch combinations to select the configuration you want are shown in Table D-1.

APPENDIX E
THE PARALLEL INTERFACE

Pin No.	Return Pin No.	Signal	Transmitter	Functions
1	19	$\overline{\text{STROBE}}$	CPU	Strobe pulse for data entry. Pulse width should be more than 0.5 μs at the receiving terminal. This signal is "HIGH" in the normal condition, and data are read in after this signal has turned to "LOW".
2	20	DATA 1	CPU	Each signal represents the information up to the first bit of parallel data. "HIGH" shows that data is logical "1" and "LOW" shows that data is logical "0".
3	21	DATA 2	CPU	
4	22	DATA 3	CPU	
5	23	DATA 4	CPU	
6	24	DATA 5	CPU	
7	25	DATA 6	CPU	
8	26	DATA 7	CPU	
9	27	DATA 8	CPU	
10	28	$\overline{\text{ACKNLG}}$	Printer	"LOW" indicates that the printer has received data and is ready to accept next data. Pulse width is about 12 μs.
11	29	BUSY	Printer	"HIGH" indicates that the printer is not ready for receiving data, while "LOW" indicates that the printer is ready for receiving data. This signal turns to "HIGH" in the following cases. **1** During data entry **2** Off-line condition **3** Error condition
12	30	PE	Printer	"HIGH" indicates that the printer is out of paper.
13	—	SLCT	Printer	Pulled up to +5V at 3.3kΩ
14	—	$\overline{\text{AUTO FEED XT}}$	CPU	When this signal turns to "LOW", paper is automatically fed one line after printing.
15	—	NC		Not used.
16	—	OV	Printer	Logic ground OV level.
17	—	CHASSIS GND	Printer	GND level of printer chassis.
18	—	+ 5V	Printer	+5V direct output.
19 30	—	GND GND		Signal GND level for twisted-pair return.
31	—	$\overline{\text{INT}}$	CPU	When this signal turns to "LOW", the printer controller is reset to the initial condition and the print buffer is cleared. The pulse width should be more than 50μs at the receiving terminal.
32	—	$\overline{\text{ERROR}}$	Printer	"LOW" indicates that the printer is in: **1.** Paper out **2.** Off-line condition **3.** Printer error
33	—	GND	—	Same as specified in pin No. 19-30.
34	—	NC	—	Not used.
35	—	—	—	Pulled up to +5V through 3.3kΩ resistance.
36	—	$\overline{\text{SLCT IN}}$	CPU	"LOW" indicates that the printer is selected.

NOTE: A line above a signal name indicates that the signal is active when "LOW".

APPENDIX F
SPECIFICATIONS

PRINTING

Printing system	Impact dot matrix, with 9 pin print head
Printing speed	Draft characters 120 characters per second Correspondence quality characters 25 characters per second High speed Elite characters 144 characters per second

Character sets:

Epson-FX/LX configuration	96 regular, 96 italic, 32 characters for each of 11 countries, 32 graphic characters and special symbols in each of draft and correspondence print styles
IBM Graphics configuration	96 regular, 133 graphic characters and special symbols in draft print style, 96 regular in NLQ print style, graphic characters and special symbols in NLQ print style
Character size	2.4 mm x 2.4 mm standard 10 CPI characters
Character fonts	Courier Citizen Display
Character matrix	Standard: 9 dot x 9 dot Double-strike: 18 dot x 9 dot Emphasised: 9 dot x 18 dot Double/emphasised: 18 dot x 18 dot Graphic characters and special symbols: 6 dot x 8 dot Near Letter quality: 24 dot x 24 dot
Bit image modes	60, 72, 80, 90, 120, 144 and 240 dots per inch

Column width

Characters per inch	Number of columns
10	80
12	96
17	136

Line spacing	1/6, 1/8 or 7/72 inch standard n/72, n/144 or n/216 inch programmable

PAPER

Paper type	Single sheets:	8-10 in. wide
	Sprocket-feed:	3-10 in. wide
Thickness	Max. 3-part forms:	0.06-0.3 mm

PRINTER

Dimensions	Height:	90 mm (without tractor-feed)
	Width:	370 mm (without platen knob)
	Depth:	238 mm
Weight	3.7 kg	
Power	Voltage:	180 ~ 264 VAC
	Frequency:	49.5/60.5 Hz
	Consumption:	100 VA max.

Ribbon	Citizen part number: Y0810-010A Ribbon life: 2 x 10^6 characters
Environment	Temperature: 40 to 95°F (5 to 35°C) Humidity: 5 to 85%, non-condensing
Printer MTBF	5 x 10^6 lines (print head excluded)
Print head life	100 x 10^6 characters

PARALLEL INTERFACE

Interface	Centronics-compatible, 8 bit
Synchronization	Externally supplied strobe pulses
Handshaking	ACK or BUSY signals
Logic level	TTL
Connector	57-30360 Amphenol

INDEX

INTERNAL SWITCH SETTINGS

Automatic Line Feed Select

Switch	OFF	ON
1	Disabled	Enabled

Select printer configuration

Switch	Epson 1	Epson 2	IBM 1	IBM 2
2	**OFF**	ON	OFF	ON
3	**OFF**	OFF	ON	ON

Epson 1 configuration:

Switch	OFF	ON
4-6	Select international character sets (see next table below)	

Forms length:

Switch	8"	11"	12"	ASF
7	OFF	**OFF**	ON	ON
8	ON	**OFF**	OFF	ON

International character sets (Epson 1 configuration) :

Switch	U.S.A.	France	Germany	U.K.	Denmark	Sweden	Italy	Spain
4	ON	ON	OFF	**OFF**	OFF	ON	OFF	ON
5	ON	OFF	ON	**OFF**	OFF	OFF	ON	ON
6	OFF	OFF	OFF	**OFF**	ON	ON	ON	ON

Epson 2 configuration:

Switch	OFF	ON
4	**High-bit control codes**	Line and block graphics
5	Switches 5 and 6 select international	
6	character sets (see next table below)	
7	**Normal (pica) print**	Compressed print
8	**Courier**	Citizen Display

International character sets (Epson 2 configuration):

Switch	U.S.A.	France	Germany	U.K.
5	ON	ON	OFF	OFF
6	ON	OFF	ON	OFF

IBM 1 configuration:

Switch	OFF	ON
4	**High-bit control codes**	Accented characters
5	**1/6" line spacing**	1/8" line spacing
6	**Enable auto carriage return**	Disable auto carriage return
7	**11" form feed**	12" form feed
8	**Courier**	Citizen Display

IBM 2 configuration:

Switch	OFF	ON
4	**High-bit control codes**	Line and block graphics
5	**Unslashed zero**	slashed zero
6	**Scandinavian characters Off**	Scandinavian characters On

Forms length:

Switch	8"	11"	12"	ASF
7	OFF	OFF	ON	ON
8	ON	OFF	OFF	ON

NOTE: Boldface shows factory settings.

CITIZEN 120D + PRINTER

QUICK REFERENCE

Print style commands

ESC k*n*	Selects Courier (n = 0) or Citizen Display (n = 1) character pitch
ESC xn (n = 1 On ; n = 0 Off)	Sets correspondence quality mode
ESC P	Selects pica pitch
ESC M	Selects high speed elite mode
ESC ~8n	Selects high-speed/normal elite mode
ESC Wn (n = 1 On ; n = 0 Off)	Sets expanded print
CTRL-N or CHR$(14)	Sets one-line expanded print
CTRL-T or CHR$(20)	Cancels one-line expanded print
CTRL-O or CHR$(15)	Sets compressed print
CTRL-R or CHR$(18)	Cancels compressed print
ESC pn (n = 1 On ; n = 0 Off)	Sets/cancels proportional printing
ESC (space)n	Increases proportional spacing by n dots
ESC a CHR$(n)	In near letter quality, justifies text flush left (n = 0), centred (n = 1), flush right (n = 2), or fully justified (n = 3) (Epson only)
ESC E/ESC F	Sets/cancels emphasised print
ESC G/ESC H	Sets/cancels doublestrike print
	Sets/cancels near letter quality (IBM only)
ESC 4	Sets italic characters (Epson only)
	Sets top-of-form at current paper position (IBM only)
ESC 5	Cancels italic characters (Epson only)
ESC 5n (n = 1 On ; n = 0 Off)	Enables/disables auto line feed (IBM only)
ESC ‾n (n = 1 On ; n = 0 Off)	Sets/cancels underlined print
ESC _n (n = 1 On; n = 0 Off)	Sets/cancels overscoring (IBM only)
ESC ~2n (n = 1 On ; n = 0 Off)	Sets/cancels reverse print
ESC S0/ESC T	Sets/cancels superscript characters
ESC S1/ESC T	Sets/cancels subscript characters
ESC h/ESC u	Sets/cancels vertically double height enlarged print
ESC ~1n	Selects combinations of double and quadruple size characters.
ESC @	Resets printer to power-on default settings and clears buffer
ESC ~3 CHR$(n)	Selects pica or elite, in normal or compressed pitch
ESC ! CHR$(n)	Selects print mode number n

Special character commands

ESC R CHR$(n)	Selects accented (international) character set n (Epson only)
	Clears all htabs and vtabs (IBM only)
ESC ~5n	Sets Epson FX (n = 0) or IBM Graphics Printer (n = 1) configuration
ESC m CHR$(n) (n = 4 On ; n = 0 Off)	
	Sets/cancels line and block graphics characters (Epson only) or accented characters (IBM only)
ESC 6/ESC 7	Sets/cancels accented characters (IBM Only)
ESC 6/ESC 7	Sets/cancels expanded printable area (Epson Only)
ESC I	Select/cancel printable area expansion (Epson only)
ESC tn (n = 0, Epson n = 1, IBM)	Selects character table (Epson mode only).

Line spacing commands

CTRL-M or CHR$(13)	Carriage return
CTRL-J or CHR$(10)	Line feed
ESC 2	Sets 1/6 inch line spacing (Epson only)
	Sets line spacing defined by ESC A or defaults to 1/6 inch (IBM only)
ESC 0	Sets 1/8 inch line spacing
ESC 1	Sets 7/72 inch line spacing
ESC A CHR$(n)	Sets n/72 inch line spacing
ESC ~0 CHR$(n)	Sets n/144 inch line spacing
ESC 3 CHR$(n)	Sets n/216 inch line spacing
ESC J CHR$(n)	One-time line feed of n/216 inches

Page design commands

CTRL-L or CHR$(12)	Form feed
ESC C CHR$(n)	Sets page length to n lines
ESC C CHR$(0) CHR$(n)	Sets page length to n inches
ESC N CHR$(n)/ESC O	Sets/cancels bottom margin at n lines
ESC 1 CHR$(n)	Sets left margin at column n
ESC Q CHR$(n)	Sets right margin at column n (Epson only)
ESC Q CHR$(3)	Turns printer deselected for diagnostic purposes (IBM only)

Horizontal tabs (htab) commands

CTRL-I or CHR$(9)	Horizontal tab (htab)
ESC e CHR$(0) CHR$(n)	Sets htabs every n columns
ESC D CHR$(n1) CHR$(n2)...CHR$(0)	Sets variable htabs at columns n1, n2 . . .
ESC f CHR$(0) CHR$(n)	Moves print head n columns to the right
ESC $ CHR$(n1) CHR$(n2)	Absolute dot tab
ESC \ CHR$(n1) CHR$(n2)	Relative dot tab

Vertical tab (vtab) commands

CTRL-K or CHR$(11)	Vertical tab (vtab)
ESC e CHR$(1) CHR$(n)	Sets vtabs every n lines
ESC B CHR$(n1) CHR$(n2)... CHR$(0)	Sets variable vtabs at lines n1, n2, . . .
ESC f CHR$(1) CHR$(n)	Advances the paper n lines
ESC b CHR$(N) CHR$(n1) CHR$(n2)...CHR$(0)	Sets vtabs n1, n2 . . . in channel N
ESC / CHR$(n)	Sets vtabs in channel n as current vtabs (Epson only)

Graphics commands

ESC K CHR$(n1) CHR$(n2)	Sets single density graphics
ESC L CHR$(n1) CHR$(n2)	Sets double density graphics
ESC Y CHR$(n1) CHR$(n2)	Sets high speed double density graphics
ESC Z CHR$(n1) CHR$(n2)	Sets quadruple density graphics
ESC * CHR$(m) CHR$(n1) CHR$(n2)	Sets graphics mode m
ESC ? n CHR$(m)	Changes from graphics mode n to m
ESC ^ CHR$(m) CHR$(n1) CHR$(n2)	Sets nine-pine graphics in single density (m = 0) or double density (m = 1) (Epson only)

Defined character commands

ESC In	Selects download characters in draft (n = 4) print. Selects standard character set in draft (n = 0) or correspondence quality (n = 2) print (IBM only)
ESC ^ CHR$(n)	Prints a single character from all characters chart (IBM only)
ESC \CHR$(n1) CHR$(n2)	Prints continuously from all characters chart (IBM only)
ESC & CHR$(0) CHR$(n1) CHR$(n2) CHR$(a) CHR$(d0)...CHR$(d10)	Define characters
ESC %n CHR$(0) (n = 1 On ; n = 0 Off)	Selects/cancels defined characters

Buffer commands

CHR$(127)	Delete last character
CTRL-X or CHR$(24)	Cancel line
ESC @	Resets printer to power on default settings and clears buffer

Miscellaneous commands

CTRL-H or CHR$(8)	Backspace
ESC U n (n = 1 On ; n = 0 Off)	Sets/cancels unidirectional print
ESC <	Sets one-line unidirectional print
ESC ~ 4n (n = 1 On ; n = 0 Off)	Sets/cancels slashed zero feature
CTRL-Q or CHR$(17)	Sets printer on-line
CTRL-S or CHR$(19)	Sets printer off-line
ESC 9/ESC 8	Enables/disables paper-out sensor
ESC >	Sets high-bit
ESC =	Sets low-bit (Epson only)
	Defines characters (IBM only)
ESC #	Cancels high-bit/low-bit code conversion
ESC EM n	Sets/cancels cut-sheet feeder

MASTER SELECT BIT VALUES

Bit	Feature	Value
0	Pica	0
0	Elite	1
1	Proportional	2
2	Compressed	4
3	Emphasised	8
4	Doublestrike	16
5	Expanded	32
6	Italics	64
7	Underlining	128

Citizen Europe Limited
Wellington House, 4/10 Cowley Road, Uxbridge,
Middlesex UB8 2XW
Telephone: 0895 72621